DOCUMENT RESUME

ED 213 110 EA 014 411

AUTHOR	Whiston, Tom; And Others
TITLE	An Annotated Bibliography on the Relationship between Technological Change and Educational Development.
INSTITUTION	United Nations Educational, Scientific, and Cultural Organization, Paris (France). International Inst. for Educational Planning.
SPONS AGENCY	Canadian International Development Agency, Ottawa (Ontario).; Norwegian Agency for Development Aid, Oslo.
REPORT NO	ISBN-92-803-1088-7
PUB DATE	80
NOTE	168p.
AVAILABLE FROM	IIEP Publications, International Institute for Educational Planning, 7-9, rue Eugene-Delacroix, 75016 Paris, FRANCE (Order No. H.36; 30.00 francs). Also available in French edition.
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Developed Nations; Developing Nations; Economic Development; *Educational Change; *Educational Development; Educational Trends; Foreign Countries; Industry; School Business Relationship; *Technological Advancement; *Technology

ABSTRACT

Comprising 387 citations, this annotated bibliography is concerned with both the implications of technological change for educational policy and the effects of education on technology. The editors' introduction gives a brief discussion of education and technology in developing and developed nations and notes that the bibliography covers only articles published in English (or in both English and French), primarily in the 1970s. The citations are presented under eight categories, including (1) the impact of technology on education and society; (2) social and educational constraints on technology; (3) technology's effects on manpower training and retraining; (4) technological change in specific industries and professions; (5) planning and development; (6) geographic, regional, and development issues; (7) educational technology, especially for the handicapped; and (8) publications by international organizations. Appended are an author index and a list of English organizations from which to get additional information. (Author/RW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED213110

Tom Whiston · Peter Senker · Petrine Macdonald

An annotated bibliography on the relationship between technological change and educational development

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☐ This document has been reproduced as received from the person or organization originating it.
☒ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY
J. Hall
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

EA 014 411

Paris 1980

Unesco: International Institute for Educational Planning

This publication arises from the IIEP research project on *Education and technological development* (directed by R. Avakov), for which financial support was provided by the Canadian International Development Agency (CIDA) and the Norwegian Agency for International Development (NORAD).

Also available (in French only)
Bibliographie annotée sur la planification
de l'éducation et le progrès technique
(oeuvres publiés en URSS en langue russe)

Composition and make-up by
The International Institute for Educational Planning
7-9, rue Eugène-Delacroix, 75016 Paris
Printed in France by Imprimerie Hemmerlé Petit & Cie, Paris

ISBN-92-803-1088-7

© Unesco 1980

Contents

Introduction 9

1. Effects of technology on education . . . 25

2. Society, technology and education. . . . 39

3. Technological change, training and retraining. . 52

4. Technological change and specific industries and professions. 79

5. Planning and development 98

6. Geographical, regional and development issues. . 108

7. Educational technology 117

8. Publications of international organizations . . 135

Addresses for additional information. . . . 162

Index of authors 164

Acknowledgements

We wish to thank the International Institute for Educational Planning for supporting this project. Also we would like to thank the numerous people who gave invaluable assistance in the compiling of this bibliography. Our particular thanks go to: I. Benson of A.U.E.W.-T.A.S.S., R. Burchell and S. Burton of the Institution of Chemical Engineers, M. Hopkins of the International Labour Office, V. Johnson of the Science Policy Research Unit's library, Dr. R. W. West of Sussex University and G.V. Wilson of the Council for Educational Technology. Finally, we wish to thank Miss J.L. Marshman, Cataloguer, University of Sussex Library, for her great assistance in locating many of the works in this text, and L. Gilroy and C. Huggett for their practical help and patience in the typing of it.

Introduction

Tom Whiston, Peter Senker and Petrine Macdonald

Viewed in the most reductionistic terms, "education" has two broad functions: the first, sometimes referred to as its "general function", is to provide a cultural service whereby an individual acquires a wide range of social and cultural skills aimed at developing his general awareness and creative ability. In one sense this addresses to the "universal" aspect of Man - his humanity and his developing consciousness.

The second function is to provide the basic skills which will be necessary for the individual to undertake appropriate employment, and also, to a varying degree, to provide more specific skills, understanding and training which will enable him to follow a particular professional career or occupation.

The relative priority assigned to these two functions varies greatly from nation to nation, and in particular as a function of ideology and level of economic development. Historically, for many nations it has been an important social principle that the "universal or general" function should be given priority; the role of the education sector has been to socialize and liberalise the individual, rather than to feed the needs of industry and commerce.

This principle has been severely eroded, even if it was ever meaningfully applied (excepting under rather selective circumstances), so that today we see the main *modus operandi* of the tertiary-education sector in terms of vocational planning.

Vocational planning is closely related to technical change, and concern with technological change is intimately related to concern with education in several ways. If society is to be changed radically by technology, then people will need to be educated in different ways in order to help devise and implement such changes and to help ensure that such changes are beneficial, so far as possible. Thus, changed education is required in order to facilitate the changing of society by technology. If technology is going to change society, education has to change so as to fit people to live and work in a new type of society. Technology can also play a role inside education, furnishing education with some of the means by which it can meet the challenges of changing society.

Similarly, though to a lesser degree, the role of the secondary education level is increasingly discussed in similar terms: either as a filter which determines participation at tertiary level, or more specifically in terms of skill provision.

In short, the "human capital" viewpoint and the manpower planning philosophy play an important role in defining many nations' views of their educational policy. This is not to say that there have not been fundamental criticisms of the ability of the State (irrespective of legitimacy) to undertake such manpower planning accurately or sensibly (see for example Carnoy, 1977; Widmaier, 1980; McCormick, 1978). Also, as recently reviewed by Carnoy (Carnoy, 1977, pp. 25-42), the role of education in relation to employment "... depends, ultimately, on how we view the functioning of the economy and its labour markets" - for instance, the orthodox theory of continuous labour markets, dual labour market theories and Radical/Marxist theories suggest very different views. If one is to understand or anticipate the nature of educational response to technological change, it is necessary to recognise these important differences in viewpoint.

Having made these general remarks, it is necessary to point out that the annotated bibliography which follows is primarily concerned with the reciprocal relationships and interactions between those processes which are broadly termed "technology" and "education", and that its remit was specifically to include only those publications which addressed themselves both to "education" *and* "technological change or technological factors" in the same paper. Consequently an important range of papers, articles and texts which consider only economic and technological change (but which may have important educational *implications* for the future) are not included. Similarly, there is an extensive literature concerned with educational policy, curricula, organizational changes, etc., which will no doubt carry wide implications for future skill provision, employment opportunity and the organization and implementation of technical change. Unfortunately this is also excluded from this bibliography.

It is therefore even more desirable to give a brief overview of the major technological, educational and socio-economic development concerns with which various nations are at present confronted (and may be increasingly confronted in the future) and against which background we may embed the more specific literature contained in this bibliography.

Education and technological development have of course to be seen in an economic, cultural and temporal context. We, therefore, divide our discussion into two parts - relating to the "developing" world and the "developed" world - as there are at present rather different problems and concerns.

However, this is not to fail to recognise that there are a wide range of mutually interactive and interdependent concerns in relation to technological change, employment and hence, ultimately, education policy. For example, the emergence of increasingly competitive (labour-intensive) economies of South-east Asia or South America carries important labour and educational implications for the North.

Similarly the comparatively rapid rate of technological innovation and diffusion in the North, which serves only to further widen the conomic, industrial and commercial disparity of the North and South, may have important implications for present education policy in the South - or at least "signals" if not implications. This may apply in particular in relation to tertiary-education policy, where expanded skill provision in the South may not be met with an equal or proportionate expansion of job opportunities.

1. The "developed nations"

Over the past century all the now "developed nations" have experienced shifts in employment from the primary agricultural and mining sector to the manufacturing sector and thence to the tertiary service sector. Nations have varied in the rate at which this has occurred, nevertheless the general pattern is more or less universal. The general movement in employment patterns has however been subject to critical analysis. Thus, in the 1960s, there was intense world-wide concern about the likely impact of technological change - in particular, concern about automation. Accordingly to some, automation was about to usher in an age of plenty for all; according to others, it was going to lead to widespread unemployment and misery (R.M. Bell, 1972).

During the early 1970s automation and other technical changes spread slowly but surely. The drive to increase productivity has of course been an important driving force of shifts in employment, such that we observe not only a quantitative shift in total skill requirements, but also a qualitative shift in skill demand. It might be considered that the extent to which the education and training sectors have been able to respond to this demand could have been critical in relation to the diffusion of new technology. This has not usually been the case, however, since the new skill level demanded by the introduction of new technology has usually been met by natural abilities and inventiveness, by training on the job, and/or has not been particularly taxing in its demands. On the contrary a large de-skilling component has been suggested for many workers, with the introduction of new technology (see, for example, Braverman 1974, Whiston 1977). Thus the introduction of a combine-harvester into agriculture, or a lathe or power-press into a factory, was fairly easily assimilated by the workforce. But increased industrialisation has generated the need for much more professional and technological manpower. This has caused some local difficulties in the rate of supply and quality of education and training.

In the early 1970s concern with other issues, such as the 1973 energy crisis and subsequent inflation, dwarfed concern with the impacts of technology on society. But now, the rapid and remorseless development of electronic technology has served to create concern once more about the impact of technological change on society.

The most crucial group of technological changes impinging now on society are concerned with the recent dramatic developments in electronic technology, in particular the microprocessor. Semiconductor electronics already made possible the development and wide diffusion of computers during the 1960s and 1970s. This was originally expected to lead to massive unemployment, in particular amongst clerical staffs. But the inadequacies of early computer equipment and the ways in which they were used probably led to more employment being created than destroyed. This was due largely to inexperience in using computing (Freeman, 1978). The experience gained, however, in the last twenty years or so will form a valuable basis for improvements in the future.

In the 1950s and 1960s electronic automation devices were relatively expensive - even in comparison with alternative mechanical and electro-mechanical devices such as timers and relays. The problems of interfacing such devices with the machines and the systems which they were designed to control were very considerable. The result was that the diffusion of automation in industry was relatively slow, with some notable exceptions such as oil and chemical process industries. Problems of unreliability were frequently encountered, but not because the semiconductor devices themselves were inherently unreliable. Experience was lacking, as with computers, and more experience was needed in such areas on how to protect devices in hazardous industrial environments.

The rapid development of semiconductor devices capable of handling and processing dramatically increasing volumes of data very reliably, and increasingly cheaply, has been paralleled by the gaining of experience of the use of electronics in a multitude of applications. Thus, many, but by no means all, of the snags have been eliminated. At the same time, many improved and new products have been developed and widely used. Computing power undreamed of forty years ago is not only now available to society, it can be made available cheaply in the classroom as well as in the office and factory.

Forty years ago, the principal means of education available were "Chalk and talk". Now, scientific experiments conducted by leading world educators can be demonstrated - and stored - to be seen and heard all over the world. However, the potential of such development has not yet been achieved.

Such developments could changed the skills required of teachers. But a most important area where technical change is likely to have an impact on education is in the area of education for work. In the first place, there is concern about the impact of technical change on the total amount of work available to be done - about the impact on employment, unemployment, participation rates (Freeman, 1978). This issue is considered below. But technical change can also affect the skills required of people at work. A substantial body of research has not yet yielded an unequivocal answer on whether technical change enhances skill requirements or reduces them. This is because there are many countervailing trends at any one moment in time. For example, mechanization of one stage of a task may lead to the creation of a substantial number of repetitive jobs, replacing skilled jobs requiring substantial education, thus lowering the average educational requirement on the shopfloor. The next stage could be the automation of the repetitive jobs, leading to a reduction in the proportion of jobs requiring minimal education.

Just as production processes change, leading to changes in the education required by the workforce, so do products. The cheapness of microelectronics is likely to lead to the substitution of electronic products for mechanical and electromechanical products. This is likely to lead to a decline in requirements for mechanical skills right through the economy - for products have to be maintained and operated as well as manufactured. Electronic products, being constructed of less component parts, require less low-level jobs to manufacture and maintain them. Some of these tasks lend themselves more to automation, and thus lessen the requirement for jobs requiring little education.

In service industries as well as manufacturing, electronics offers the possibility of eliminating jobs requiring intermediate levels of educational attainment. Word processors and other information-processing technologies offer the possibility of increasing the productivity of office clerical work.

One of the problems with any study of the consequences of technical change for the training and educational requirements of jobs is that such studies have to operate to some extent in a static framework. It is quite conceivable that much employment in jobs requiring very high levels of education is related not to the particular state of technology at the time, but to its *rate of change*. Many highly trained and educated people may be needed to change the design of products, processes and organizations in an environment of rapid technological change. This applies not least to education itself, in which the teachers require constant re-education in order to equip themselves and their pupils for work and leisure in a changing world.

There is a considerable amount of choice in the ways in which society can use the opportunities which technological change opens up, which may reflect the diversity of views which are expressed in the literature. There are many jobs which require low levels of education, or which are carried out in environments which are very hostile to human beings. Technological developments offer the possibility of eliminating many of these jobs.

But these objectives may not always be primary in the minds of those responsible for industrial operations. A job in a hostile environment may continue to be performed by a human being, instead of a mechanized or automated machine, because short-term cost considerations indicate that the human being is cheaper, without taking into account the long-term deleterious effects of the environment on the human being. An automation scheme may eliminate some skilled jobs, and the requirements of the new process may dictate some very repetitive jobs at another stage in operations, because the total consequences and impacts of the new scheme on the whole production operation have not been thought out fully and comprehensively.

If technical developments lower the requirements for labour in the total man-years, then there must be concern about unemployment. But this possibility is based on the assumption that work will be badly distributed. Technical change, instead of causing unemployment, can be used to create the opportunities for people to have continuing, lifelong education. Instead of a population being unemployed, a similar proportion could be taking periods off during their working lives for further education, both to suit them for changing job roles and also as personal enriching experiences. More people could spend more time looking after their children in their formative years, and less people could be required to work "unsocial hours". Here again, this possibility may be negated by the desire to get the maximum production from expensive machinery.

Concomitant with this changing technological face of society there also occurred, in most developed nations, a substantial increase in the level and form of provision of "formal education" programmes. Various thresholds or barriers were penetrated: universal primary and secondary education, significant increases in the participation rate in higher education. In the United Kingdom, for instance, the important "Robbins principle" emerged, whereby educational provision at the tertiary level was designated a "free-demand" social right, though commensurate with appropriate entry-qualifications. Nevertheless, the extent to which socio-economic and "social class" factors play a dominant role, or the restrictions of student-grant or loan availability act as an important controlling factor, varies greatly from country to country.

The labour shifts, technological developments and expanded educational policies which have thus occurred have resulted in a range of problems and questions in relation to the interaction of educational provision and occupational demand - for instance, with respect to the appropriateness or "matching" of educational supply and vocational demand; the "over-provision" of graduates; the "undemanding nature" of many jobs (see Rumberger, 1978; Whiston, 1977, 1978a); and so on.

However, by far one of the most wide-sweeping "debates" which has developed in relation to the emerging and future relationships of socio-economic change, technological development, occupational styles and education provision has been the concept of the Post-Industrial Society, of which the main proponent is Daniel Bell (Bell, 1974). Central to the concept of post-industrial society are three underlying themes: firstly, the labour shift through primary to secondary to the tertiary sector will continue to an extent beyond that at present observed; secondly, that the nature of manufacturing (and many service) industries will be such that they will come to depend more and more upon an informational and "cybernated" society; and thirdly, that educational provision will continue to grow both in extent and form. For example, the participation-rate in higher education will be seen to continue to grow significantly and an increasing move towards "continuing education" (re-entry over one's entire life-span) will occur.

This view of future society, and in particular its relation to the education sector, would if it emerged (to a greater extent than it may have done already) herald important implications for the subject matter considered here. However, the PIS concept is not without its critics, doubts and problems (see, for example, Gershuny, 1978).

Unfortunately for the Bellian view of future societal developments, there are at present several internationally common factors which do not readily fit into this scenario in the sense of permitting "easy transition" into such a society (were it universally wanted).

For over and above the ever-present problems of international tension and conflict, there are fundamental problems in relation to: (a) high levels of unemployment (which many analysts do not see as a temporary phenomenon); (b) doubts as to the future practicality of economic growth; (c) suspicions that with recent computing and engineering development and innovations the nature of skill demand will be severely modified, though still requiring a fairly high "unskilled or semi-skilled" component. Seen separately each of these factors carries important implications for the education and training sectors. In combination they throw pragmatic doubts on the viability of the PIS concept.

For example, the adherents of this concept might see society as being at the doorstep of major change and social reorganization. Those of a more pragmatic leaning would point to a range of social disabilities, political problems and institutional difficulties. However, other analysts do recognise that the developed nations are at some form of turning-point in relation to the future pattern of work-styles, occupational classification - and in relation to these, the role or relevance of present education policy and styles (see, for example, Husén, 1974; Stonier, 1978).

Whilst the concept of PIS, or the social consequences of the "micro-processor revolution", are open to debate and point to the urgent need for empirical enquiry, there are however two important factors which are with us now and which carry considerable weighting for our views on future education policy and planning. The first factor relates to the level of public expenditure on education, and the second to present demographic factors.

With regard to educational expenditure, there has perhaps now come a point where for many countries the education sector's share of GNP or total government expenditure has neared its politically acceptable limit. For many countries (both developed and developing) further educational expansion, at least in line with the previous two decades, is being seriously questioned and challenged.

There are a variety of political as well as economic reasons which will not be discussed here. However, it is important to recognise that the education "boom" of the 1950s and 1960s peaked some time ago. Critics query the economic yields of such programmes, whilst advocates point to the social and human gains.

Analysis of this decline in political will to provide increasing educational facilities, thus reducing the rate of expansion of education provision, is of course closely related to the international inflationary scene; however, several analysts have suggested that even in the event of economic resurgence, it is quite possible that we will not observe a return to the educational projectory of the 1950s and 1960s.

Analysis of this aspect is further complicated by our second factor - the changing demographic base to which education programmes at present relate.

It is perhaps ironical that at almost the same point in time that world economic recession developed, most developed nations observed significant shifts in the birth-rate and age-profile distribution of their population. Accompanying this demographic shift, we encounter a reduced entry rate into primary (and shortly into secondary) schools, and a decade from now a proportionally reduced input into tertiary education, unless alternative participation policies are followed (see Whiston, 1978c). Meanwhile, however, there is now increasing pressure on the tertiary education sector owing to a comparatively high birth-rate in the early 60s at a time when unemployment is high, and economies rather stagnant. Policy response is even further complicated by an increasing recognition in several developed countries of impending technological changes which may merit radical re-organization of manpower provision, planning and training (see Freeman, 1978).

Governments can use demographic trends as a justification for policies designed primarily to contain public expenditure and reduce inflation: for example, reduction of teacher provision at primary and secondary level. Similarly, with respect to the tertiary education sector, a perceived lessening of future demand may be used to justify policies of restraining expansion, provision, and participation at universities and colleges. But the extent to which such policies are appropriate to future technologies and *social* needs, is debateable (see Whiston, 1978b). Such a dilemma presents a range of difficulties in relation to educational planning, towards skill provision, towards retraining and overall social policy. For instance, restrictions in educational provision now may increase many future burdens in relation to technological change - not least its social acceptance. Similarly, if the consequences of recent technological developments create the need for alternative labour-intensive employment areas outside the manufacturing and present service sectors, then there may be need for a radical restructuring of education policy and provision.

But there is a relationship between education and technology which may play a more dominant role in the future in relation to costs and provision: namely, educational technology.

During the 1950s and 1960s many educational technologists considered that a combination of programmed learning, teaching machines and audiovisual aids would offer a significantly improved teaching system. Others were highly sceptical of "behaviouristic" technology, seeing this as limited in scope, primarily suitable only to numerate and engineering subjects and at best a limited teaching supplement. Yet others saw the techniques as "teacher-displacing". In the event the feared revolution did not occur. (Similarly, the consequences of automation in the late 1940s, 50s and 60s were not as immediate as Weiner feared (Weiner, 1954, Bell 1972)). Programme learning and teaching machines found only limited application and certainly did not displace teaching labour. This may have been for a variety of reasons - inadequate equipment, inappropriate systems design, lack of operational and programming back-up or real lack in operational potential.

However, the 1980s may be considerably different with respect to "educational technology". Firstly because of operational reasons - significantly more sophisticated equipment with much wider versatility (computing techniques, computer-assisted learning, distance learning systems, media influences/ radio broadcasting, television and recent developments in two-way communication systems); and secondly, since the education expansion mood of the 1950s and 1960s is now contained if not reversed, then if real cost savings can be demonstrated by such system provision, agreements for wider application may be considerably more forceful, irrespective of the potential social, control problems which may be attendant with these techniques, (e.g. home-based learning at the tertiary level; and other dangers of mass-communications systems).

The degree to which educational budgets are constrained in general, the effect upon tertiary education and the general economic and technological influences will no doubt vary from country to country; however, we may see over the next decade an homogenisation of problems, if not of response patterns.

2. The "developing nations"

There is little difficulty in demonstrating the enormous difficulties which confront the developing nations who are involved in the gargantuan task of attempting either to transfer their economies from that of primary-resource suppliers for the industrialised nations to self-sufficiency or, perhaps under restricted circumstances, to keep up with the massive growth in population which has occurred in recent decades - in terms of "basic needs" resource provision and also in terms of social provision.

In many cases, of course, economic and social battles are being simultaneously undertaken on both these fronts; which entails enormous demands on political will, or socio-economic strategy, and on the development of "human capital resources" where the formal-education sector may play a very important role.

Unlike the developed West, the developing nations are faced with two dilemmas which carry a multitude of implications or problems with respect to policy formulation in the education sector.

Firstly, as mentioned earlier, there is the problem as to whether resources should be primarily directed towards "primary-education" schemes, towards literacy campaigns (geared at all age-groups), and ultimately towards long-term goals where the introduction and temporal extension of universal-education schemes strive towards economic and social well-being and/or whether priority should be given towards the expensive tertiary sector (see Whiston, 1978c) which may produce the engineers, scientists, technologists and administrators necessary to man the embryo or developing industries which might serve to generate increasing national wealth.

Profound doubts, however, have been generated over the past decade as to the viability of this route (see for example, Adiseshiah, 1980). Fundamental doubts as to the developing countries' ability to compete with the "developed North" for a variety of exogenous and indigenous reasons has become widespread. This may be seen in terms of dependency theory, in terms of human capital approaches, or in terms of socio-cultural factors.

Irrespective of the underlying casuality, the production of numerous graduates and post-secondary-trained individuals who are not able to obtain appropriate employment (see Adiseshiah, 1980; Carnoy, 1977) presents an immense problem for the formal education sector of many developing countries. The escalating nature of this problem has been reviewed by Dore (1977), whose analysis of the diminishing returns to the educational ladder-climber, whilst directed towards developing countries, is not so different from the Hirschian analysis of developed countries' problems (Hirsch, 1977).

The majority of developing nations have, for both social and economic motives, devoted over the last two decades an increasing proportion of their GNP - in some cases exceeding 10 per cent - to the education sector, and yet despite these massive efforts have not been able to keep up with the natural increase in population growth.

The combination of these two factors - the scepticism as to the ultimate economic rewards of massive educational expansion, and the recognition that educational expenditure may now have reached a plateau - may carry important pointers towards future education policy.

This is not to say, as discussed earlier in the case of developed nations, that an expansion of the formal-education network through technological means will not develop on an even larger scale. Despite massive effort towards universal-literacy campaigns much still remains to be done and may be subject to the success or otherwise or more recent technological developments (stationary satellite, TV schemes, etc.).

However, success or otherwise at the literacy level and at primary level does not relieve the strategic problems relating to the tertiary-education sector, which are ultimately a function of the social and technological goals which individual countries set themselves: e.g. labour-intensive agricultural and basic-need arguments; appropriate technology concerns; degree of capital-intensive strategies, etc. It is the nature of this goal which constitutes the *second* major problem confronting education "policy" and in particular its relationship with technological change.

Technological change, technological demand and education response at the "supply" level might suggest that "technology" in the Western sense becomes a dominant component of the way of life in developing countries. To a certain degree such a view is being increasingly questioned, in terms of "labour-intensive" philosophies, "appropriate-technology" applications, and, in combination with these views, in an emphasis upon essentially agricultural economies rather than Western-style industrial economies.

Such a "debate" has to be seen however against the economic, political and industrial realities of, on the one hand, those developing countries who are at present engaged in major developments of various industrial sectors and, on the other hand, the ultimate trade and development consequence of the "North-South" dialogue.

It is possible that the next decade will reveal markedly different world trade relationships and through this define a variety of training and educational needs in developing countries which cannot at present be defined.

In many LDCs the "modern economic sector" occupies only a relatively small proportion of the total labour force (in India, 20 million out of 220 million). "Formal" education policy nevertheless has in the past been dominated by the perceived needs of this minority sector. To a certain degree the increasong recognition of a segmented or dual economy is forcing policy-makers to recognise the needs of this second major component also as a rightful claimant to the attention of education programmes - an increasing "relevance" of the education sector to producing skills appropriate to essentially agricultural and rural communities; and to the "base needs" of these communities. This still implies many forms of future technological changes, but in a form different from that generated by a capital-intensive industrial programme.

Whether or not the skill provision will be provided by the "formal" education sector or an expanding "informal" education sector remains to be determined.

Clearly, the whole area covered by this Bibliography is one in which much more research is required. The rapidity of change in both technology and education itself ensures that research becomes outdated very rapidly. Perhaps one point stands out more clearly than others. The types of research undertaken and the results obtained are coloured very much by the perspectives of those undertaking the research. The results of the interplay between education and technology are only partly inevitable. To a large extent, they can be modified and directed to serve society's needs better.

In compiling the bibliography several principles have served to guide the authors. Firstly, as indicated earlier in this introduction

> the annotated bibliography which follows is primarily concerned with the reciprocal relationships and interactions between those processes which are broadly termed "technology" and "education", and that its remit was specifically to include only those publications which addressed themselves both to "education" *and* "technological change or technological factors" in the same paper. Consequently an important range or papers, articles and texts which consider only economic and technological change (but which may have important educational *implications* for the future) are not included. Similarly, there is an extensive literature concerned with educational policy, curricula, organizational changes, etc., which will no doubt carry

> wide implications for future skill provision, employment opportunity and the organization and implementation of technical change. Unfortunately this is also excluded from this bibliography.

Having made this proviso it is inevitable that many sources would prove not to be equally balanced in their discussion of education and technological issues - and in some cases there would be a preponderance of one single aspect. We have therefore attempted to interpret the "dual remit" of education *and* technology with as much sensibility as possible and to include certain articles which, though leaning heavily toward one aspect, are nevertheless considered significant contributions to the literature.

The articles and papers included in this study tend to cluster at three levels: (a) fairly "Broad-brush" texts which raise a wide range of issues, often including a wide range of social and political issues (e.g. Bravermann); (b) more specific sources which centre upon narrower technological areas; (c) articles which are highly specific - for instance in relation to "educational technology"; and (d) relevant texts published by international organizations[1]. The compilers have aimed, though this may not have been fully achieved, at providing a balanced sample of these various forms of literature.

Similarly, the bibliography is entirely restricted to English-language articles or articles published in English and French, and primarily covers literature of the 1970s. In centring upon this time period, an unintended potential bias has to be recognised and, we hope, overcome: the literature of the late 1970s has tended to centre upon the "microprocessor revolution" discussed earlier in this introduction. This topic, of undoubted importance, has tended to dominate the literature, whilst much of it is of an understandably unproven nature. In a bibliography of this form it is essential that the material be as contemporary as possible, whilst at the same time it was thought desirable to provide a balanced weighting of material discussed over the last decade. It is to be hoped that this has been achieved.

Besides consulting previous abstracts, all relevant major journals and library sources, it was also thought beneficial to solicit the views of various interested and specialist organizations and individuals who were considered to have useful experience in this field, with a view to soliciting views as to the range of sources which might be considered for inclusion in this bibliography - and whose help we acknowledge at the beginning of this text. Similarly, it was thought useful, bearing in mind the ongoing nature of the literature, that the reader might benefit from addresses and sources of information, which we found particularly helpful and which we have therefore included at the end of this text. The assistance of these organizations is gratefully acknowledged.

---

[1] A number of the annotations included under this heading have been prepared by M. Coussenib, to whom our thanks are due for this assistance.

With respect to classification of the material, it was decided that the most appropriate categories would be in the form listed below. Such a classification is inevitably somewhat arbitrary, but, we hope, provides some gains. In formulating these categories, three viewpoints are dominant: firstly, the *implications* of technical change for education policy; secondly, the *consequences* of education policy upon technological change (through a variety of routes - skill provision (or non-provision), social expectancy, r and d capability, etc.); and thirdly, the general *interaction* effect of both areas (e.g., level of economic activity, resources available for public spending, level of social provision and expectancy). To these should be added the highly specific area of "educational technology" - i.e., the specific application of various technological innovations within the education arena.

These four aspects have tended to influence the choice of sub-categories; nevertheless, location of any particular article has not always been obvious and much cross-indexing is required.

Similarly, within each of the bibliographic sections the compilers have attempted to include both specific and general articles. The reader who consults the more general texts will undoubtedly generate a more extensive bibliography for himself, as is the nature of any retrieval system. In addition we have sought to include a few press or "non-academic" articles where these are thought to contain a range of discussion or insight not always present in more "formal" articles, as a means to providing a contemporary flavour.

Finally, in relation to developed and developing country issues it was found that since this cut across so many subcategories, rather than providing a unique classification it was more satisfactory to include such articles across the seven categories listed below.

1. *Effects of technology on education.* The papers in this section are mainly concerned with the general impact of technological change on education and society.

2. *Society, technology and education.* We include in this papers which deal with constraints on technical development arising either from shortage of necessary skills or from general societal problems.

3. *Technological change, training and retraining.* This section includes papers on the influence of automation on manpower and training requirements and the diverse needs of different

sections of the work force.

4. *Technological change and specific industries and professions.*

5. *Planning and development.* This section also includes papers concerned with possible future structures of society.

6. *Geographical, regional and development issues.*

7. *Educational technology.* This section includes papers concerned with new educational approaches made possible by technology. A subsection is concerned with educational technology for the handicapped.

8. *Publications of international organizations,* including both official and non-official productions.

References

ADISESHIAH, M.S. "Future Asian education", in R. Avakov (ed.), *The future of education and the education of the future.* Paris, IIEP, 1980.

BELL, D. *The coming of post-industrial society.* London, Heinemann, 1974.

BELL, R.M. *Changing technology and manpower requirements in the engineering industry.* Sussex University Press (in association with the Engineering Industry Training Board), 1972.

BRAVERMAN, H. *Labour and monopoly capital: the degradation of work in the twentieth century.* New York, Monthly Review Press, 1974.

CARNOY, M. *Education and employment: a critical appraisal.* (Fundamentals of educational planning, 26.) Paris, Unesco: IIEP, 1977.

DORE, R. *The diploma disease: education, qualification and development.* London, Allen and Unwin, 1976.

FREEMAN, C. *Government policies for innovation.* The Ninth J.A. Bernal Lecture, Birkbeck College, London, 1978.

GERSHUNY, J. *After industrial society?* London, Macmillan, 1978.

HIRSCH, F. *The social limits to growth.* London, Routledge and Kegan Paul, 1977.

HUSEN, T. *The learning society.* London, Methuen, 1974.

..... *Talent, equality and meritocracy.* Project 1 - Educating man for the 21st century.) The Hague, Martinus Nijhoff, 1974.

McCORMICK, K. "Manpower forecasters as lobbyists", in *The uses and abuses of forecasting.* London, Macmillan, 1979.

RUMBERGER, R.W. "Overeducation in the U.S. labor market." Unpublished Ph.D. dissertation, Standford University, July 1978.

STONIER, T. "A profile of the post-industrial society", in R. Page (ed.), *Strategies for change in a technological society*. Bath University, 1977.

WEINER, N. *The human use of human beings*. New York, Houghton Mifflin, 1954.

WHISTON, T.G. *Education, workstyles and social development: a mismatch of abilities*. 139th Meeting of the British Association for the Advancement of Science, Aston University, 1977.

..... "Education and the maximisation problem: a romantic viewpoint?", in P. Holroyd (ed.), *Collected readings of Conference on education and unemployment (UK Futures Network)*. St. Helens, Pilkington, 1978(a).

..... "Demographic forecasting and education policy.", Chapter 7 in *The uses and abuses of forecasting*, op. cit. 1978(b).

..... "The development of education: its technological and social dimensions", in *The future of education ...*, op. cit. (1980)

WIDMAIER, H.P. "Basic needs in the social and educational sector and state policy (an alternative to the human capital approach)", in *The future of education ...*, op. cit. (1980).

I. Effects of technology on education

1. AVAKOV, R. "Education and technology: two processes in constant interaction". In *IIEP Bulletin*, No. 3, 1976, pp. 4-5.

The importance of research into the close relationship between education and technology is discussed: on the one hand the education system is faced with problems created by technological change and the process involved in the transfer of technologies and on the other hand the technological process is itself conditioned by the educational system. Reasons why this research has been neglected in the past are considered. The objectives of the International Institute for Educational Planning's research project on this theme are presented. The aims of the study are: to define the conceptual framework of the problem, to carry out a programme of research, and to incorporate the problem within the training programmes of planners of the "education" and "technology" systems, seen as an integrated process. The methodological difficulties are outlined, the lines of approach the study will follow described and the importance of placing the study in both a national and international context emphasised.

2. CARTER, CHARLES. *Higher education for the future*. Oxford, Blackwell, (Mainstream Series), 1980 (160 p.).

The author, Chairman of the Research and Management Committee of the Policy Studies Institute, London (and vice-chancellor of University of Lancaster, 1963-79), considers the national needs for higher education policy in relation to the cultural, social, technical and employment problems now confronting the United Kingdom society. He argues that there should be a continuing and public review of the purposes, structure and methods of higher education. He describes the organisation and nature of the goals of higher education and what changes are needed in the next two or three decades in the content and method of teaching, in the forms of examinations, in the commitment to research and public service, and in the ways of governing and financing higher education.

3. CERYCH, L. (ed.). *Between school and work*. Paris, European Cultural Foundation Institute of Education, 1976 (200 p.).

Papers presented to an international symposium on education and work held in Madrid at the end of 1974. The discontinuity between general and vocational education is considered. Society's increasing sophistication and technical character means that this discontinuity is one of the most acute problems of our time. New solutions to the problem concerning the upper and post-secondary levels of education are presented.

4. COOKE, R. "New patterns for learning". In *Practical Computing*, 1979, Vol. 2, No. 5, 1979, pp. 83-84.

Considers the need for a review of education and re-education policy in relation to the skill changes resulting from micro-electronic applications.

5. COULSON, E.H. "Scientific education in the 1990s". in Society of Chemical Industry, *Chemistry and industry in the 1990s* (The Lancaster Symposium, 1969). London, Society of Chemical Industry, 1970, pp. 180-187.

The development of science education from 1939 to the present day is reviewed. The Nuffield Science Teaching Project and projects set up by the Schools Council and the School Sciences and Technology Committee are discussed. There is need for greater awareness of the importance of technological advances to future national prosperity and of encouraging people to take up science-based careers in industry. Educational technology provides opportunities and benefits for science education. The future role of science in the school, technical college and university curriculum is considered. Science must aim to serve society by providing an essential contribution to a liberal education so that individuals can understand their environment and the work of scientists and technologists. It must also be presented so as to stimulate a sufficient number to take up careers in both pure science and technology. A possible future learning programme for science in schools is outlined.

6. CRAUSAZ, R. *Diversification of tertiary education*. Strasbourg, Council for Cultural Co-operation, 1974 (41 p.).

A policy of diversification of education rather than expansion is currently being implemented in many countries. An increasing demand with new needs, both in nature and quality, for people with different types of training and abilities, requires tertiary education to reconsider its function and aims. Among the topics discussed are access to higher education, new types of institutions, and curricular reform and development. A theoretical discussion of aims, resources and implications of diversification is illustrated with case studies.

(Abstracted from IIEP Bibliography, Paris, 1968.)

7. DANIELS, D.J. "Industrial chemistry and the sixth form". In *Education in chemistry,* Vol. 7, No. 3, May 1970, pp. 108-110.

Attempts to increase the links between schools and industry by making A-level science courses more relevant to industry's needs and to increase the awareness of the technological and applied aspects of science are considered. Although this has been attempted in the past, it has only recently been accepted that the curricula and methods must be adapted to meet the present-day demands of society. The difficulties of including more industrially-biased work into the curriculum are discussed.

8. EDGLEY, R. "Education in industry". In *Educational research,* Vol. 20, No. 1, 1978, pp. 26-32.

This paper considers the proposition that by the standards of industry, education is inadequate and that only by aspiring to these standards will education reach the required level. The major criticisms of education generally expressed are outlined, which spring from a belief that there are "gaps" between education and industry where there should be links. The major criticisms are that the subjects studied by students are inappropriate and that the standards attained are not high enough. Taking the American experience of modern technology and automation as as example and using Braverman, Marx and others to reinforce the argument, the underlying assumption of these criticisms, that modern industrial development requires an increasingly skilled workforce, is attacked. Having argued that modern industry does not need a highly educated or skilled labour force it is suggested that "behind the current industrial demand for a more educated workforce lies the hope that more education of the kind suggested will help restore among the students the discipline needed in the subordinate ranks of industry's political hierarchy" The idea that the gap between industry and education is in fact an inconsistency between education and occupation is examined. It is concluded that one must consider whether our liberal democratic civilisation, which is the civilisation of industrial capitalism, is fit for people.

9. EDWARDS, SIR S., FRS. "The urgency of education". In *New Scientist*, Vol. 78, No. 1106, 8 June 1978, pp. 656-657.

Changes in population and employment will be the main factors affecting the reaction of education to the rising tide of automation. The education and training of doctors is contrasted with that of engineers, whose professional training is less well directed. Vocational training for skilled workers should be undertaken in schools. Retraining is neglected in Britain compared with France and Germany. The techniques used by the Open University could be used to revolutionise teaching in schools.

10. FAIRBAIRN, A. "School-industry liaison: a county scheme". In *Industrial and commercial training*, Vol. 9, No. 11, November 1977, pp. 464-467.

The work of Leicestershire Committee, under the auspices of the Education Committee, to encourage, facilitate and initiate liaison work between education and industry is described. It is recognised that there is a vital need to bring education, particularly in the schools, and industry closer together and two schemes which attempt to do this - "Teachers to Industry" and "Industrialists Back to School" are discussed.

11. HAY, G. "Aladdin and his electronic lamp". In *Where*, No. 154, January 1980, pp. 13-14.

G. Hay, the Secretary of TEACH (Technology: Education and Change), examines the impact of the "silicon chip revolution", and warns of the consequences if our education system fails to prepare children for a "life of change". He also reviews "TEACH" in making all levels of society aware of the consequences of technical change, (especially micro-processors) and their educational and social consequences or requirements. (Includes courses, bibliographical material, conferences and national policy requirements. Refers also to the School of Systems and Computing at Thames Polytechnic.)

12. HOLDING, D.H. "Training for skill". In D. Pym (ed.), *Industrial society: social science in management*, Harmondsworth, Penguin Books, 1968 (pp. 34-152).

The laboratory study of skills is considered. The central role of information in instruction, the use of electronic training simulators and the use of concepts such as feedback, perceptual cueing and evaluation are explained. The importance of sound training practice is emphasised.

13. HOOPER, R. *National development programme in computer assisted learning: final report to the director*. London, Richard Hooper, Council for Educational Technology (CET), 1977 (200 p.).

The report summarises the work and conclusions of a 5-year National Development Programme through which the United Kingdom has established itself as one of the world leaders in CAL. Reviews progress in CAL and considers future policy.

14. HUSEN, T. *The learning society*. London, Methuen and Co. Ltd., 1974 (266 p.).

This collection of essays considers the role of schooling in society, the possibilities and problems of "lifelong education". It is argued that unless our society can become a "learning society", it will never be able to keep up with its increasingly complex technological future. Continued education is the only way to cope with society's strenuous demands. A number of educational topics, are discussed including the school and society, education in developing countries, strategies of educational innovation, educational technology, and educational planning and education towards the year 2000.

15. HUTCHINS, R.M. *The learning society*. Harmondsworth, Penguin Books, 1968 (141 p.).

This book discusses issues in education which are brought about or accompanied by affluence and technological change, by the evolution of a world community and the dissolution of the class structure. The aim of education is examined and it is argued that if universities merely process students for success in industrial society, then the technology which has freed man from drudgery in many societies will leave him fit only for "bread and circuses". The aim of education must be the fuller realization of manhood, not manpower. The idea that education and in particular scientific and technical training is the road to economic growth is critically re-examined in relation to developing and industrialized countries and it is concluded that "directing (education systems to superficial means of training for economic growth will probably fail to meet any defensible definition of education or to produce economic growth". The technology of education is also discussed.

16. KATRITZKY, A. "Industrial cooperation and other academic experiments". In *Chemistry in Britain,* Vol. 12, No. 8, August 1976, pp. 251-254.

The importance of academic-industrial co-operation is emphasised and the development of programmes to strengthen such links by the chemistry faculty of the University of East Anglia is discussed. Ways of making close contacts with industry include consultancies, industry-based higher degrees and a visiting faculty from industry scheme. These, together with educational innovations which have not proved successful, are described.

17. LARGE, P. "Technology upsets the cloistered halls of teaching". In *The Guardian,* 2.11.78.

The virtual impossibility of adapting the education system to the increasing pace of technological changes is examined. Representatives of the educational establishment at a meeting organised by the Standing Conference on Schools, Science and Technology generally agreed that there must be a shift in schooling from the abstract to the practical and that the change must reach the primary school. The problem of the decline in work for the unskilled resulting from the wide use of microelectronics is discussed and it is felt that if the unskilled were not given the opportunity of developing creativity "vandalism would increase and revolution would follow". The need for the educational system to respond to the present shortage of engineers and designers is also discussed. The possibility of Britain expanding her agriculture and encouraging sidestream areas of technology is presented as an alternative to adopting the strategies of the Federal Republic of Germany, Japan and the United States of America.

18. LASZLO, E. *The education of educators.* Paris, International Institute for Educational Planning, 1978 (16 p., roneo).

The problem facing education: that society and the needs of society are changing far more quickly than the education system itself is considered. It is argued that educational reform must attempt to bring education and society more closely together. The first step must be to create a corps of more informed and involved educators. This cannot be left to chance and a conscious and systematic plan must be evolved to encourage a constant and reliable flow of intellectually equipped people into the policy-making environment. The problems of creating such a corpe are discussed and a five-phase plan which would encourage and nurture such "new educators" is presented.

19. LAUWERYS, J.A. and SCANLON, E.G. (eds.). *Education within Industry*. London, Evans Brothers Ltd., 1968 (382 p.).

Industry's influence and contribution in the field of educational progress is considered. The demands of technological and industrializing societies impose a necessity for matching educational output with professional man-power requirements. The evolution of present educational structures and the ways in which they are being modified as a result of the increased involvement of state and industry are discussed. Theoretical issues, national and historical studies and selected case studies from major industries and firms throughout the world are discussed.

20. LE THANH, K. The future shape of education?". In R. Avakov (ed.), *The future of education and the education of the future*. Paris, IIEP, 1980, pp. 65-74.

The role of forecasting in educational planning is discussed. Forecasting must operate within a national framework and be based on an accurate knowledge of the present if it is to assist in policy-making. Statistical forecasts on a world or regional basis are of no use unless they stimulate international co-operation. Recently, wealthy countries have allocated less of their GNP to such co-operation than formerly. However, in a subregional context and for countries faced with common problems, benefit may be derived from a forward-looking analysis of the conditions which would enable the functioning of the educational systems to be improved with the help of the experience of other countries and their views of the future of sciences and technologies which could influence education. Even if the country does not control all these variables, forecasting and planning are essential because they give direction to its policy.

21. LINSTONE, H.A. "The future of education: a global long-term perspective". In R. Avakov (ed.), *The future of education and the education of the future*. Paris, IIEP, 1980, pp. 246-258.

The future of education and a number of challenges which education must respond to are considered. The discussion is based on the assumption that the transition to a "new kind of world" will occur within the next two generations. It is argued that there is a need to "demythologise science"; "false idols such as objectivity and quantification must be unmasked". Also, education must try to increase students' awareness of future problems and alternatives and, thereby, extend their planning horizons. The need to make young people aware of the value and potential of both the local community and the global entity is discussed. Education and bureaucracy; the role of education in developing the ability to access information, lifelong education and the importance of retraining and multiple careers in a rapidly changing world are topics which are also covered. The question of what education can and should do is considered.

22. MACK, D. "Education for an industrial society". In *The Times Educational Supplement*, 7.4.78, p. 39.

The five-year "Education for the Industrial Society Project" which was launched in Scotland in April 1977 is described. This project attempts to tackle the problems which give rise to the debate which on the one hand argues that in schools education for working life is inadequately stressed and on the other hand argues that employers make absurd demands on schools. The basic approach of the Project Committee is discussed and whether an effective curriculum can be evolved for all pupils which serves both their interests and the needs of a rapidly changing society is considered.

23. MARLOW, L.H. "An age of technological development". In *NUEA Spectator*, Vol. 40, No. 24, June 1976, pp. 29-32.

It is argued that science and technology have exerted a major influence on higher education/continuing education over the period 1960-75. Areas which are discussed include: the increasing number of part-time students, the role of continuing education opportunities, personal concern for the "obsolescences" of skills. Other items considered include the areas where there may be a lack of information concerning educational or skill opportunities and also the way in which management cope with changing situations.

24. MERTENS, D. *Key qualifications in basic and further education.* Strasbourg, Council for Cultural Co-operation, 1972 (18 p.).

Education must respond to changes in job content, skill requirements and the emergence of new jobs. Identifying the factors favouring adaptation to the future evolution of jobs ("key qualifications") and drawing the consequences for education is one possible solution to the problem. This idea is discussed and the future labour market and the actual and potential flexibility of the employment system are examined.

(Abstracted from IIEP Bibliography, Paris, 1978.)

25. MESTHENE, E.G. *Technological change: its impact on man and society*. Cambridge, Mass., Harvard University Press, 1970 9127 p.).

While technological innovation creates many diverse opportunities, it also leads ultimately to a need for social and political innovation if its benefits are to be fully realised and its negative effects kept to a minimum. Technological change is discussed in relation to social change, changing values and economic and political organisation. The benefits and shortcomings of educational technology are discussed and the importance of an educated public for the proper use and understanding of society's technological potential is stressed. The need for education and training to cope with the complexities of the modern world is also emphasised.

26. NIBLETT, W.R. (ed.). *The sciences, the humanities and the technological threat*. London, University of London Press, 1975 (168 p.).

Places of higher education are major and necessary sources of the technologists and experts our society must have. This collection of papers considers how to counter the threat to their humanity which the detachment of their work entails and how to encourage and preserve the "humanness of human beings" in the period we are entering. The dominance of the technological approach over what is studied in higher education must be countered and reduced. It is not enough for universities to teach subjects well or train their research workers efficiently, relying upon "progress", upon mere technological expansion, as the goal.

27. PIELE, P.K., EIDELL, T.L., SMITH, S.C. *Social and technological change; implications for education*. Eugene, Oregon, Center for the Advanced Study of Educational Administration, University of Oregon, 1970 (CASEA Monograph No. 22, 331 p.).

This collection of conference papers on the educational implications of social and technological change in the United States of America considers alternative futures and trends in education. It discusses the pressure exerted through occupational organisations and other interest groups of teachers and the implications that this has for the schools. The system design approach to educational planning and management information systems are also discussed.

28. REISMAN, D. "Leisure and work in postindustrial society". In S.D. Douglas (ed.), *The technological threat,* Englewood Cliffs, New Jersey, Prentice-Hall, 1971, pp. 71-91.

The role of leisure and work in American life and the uneven distribution of leisure in terms of differential attitudes to work in different occupational groups is considered. For many people, suddenly acquiring more leisure time amounts to technological unemployment for which their education has not prepared them. Emphasis should be placed on educating people to use their leisure creatively and jobs must be structured so that they are more creative and demanding. In this way work and leisure may merge in the future. This re-ordering will be difficult because of the lack of interest shown by both unions and management.

29. ROBINSON, E. "Appropriate teaching and learning methods". In *Training officer,* Vol. 12, No. 7, July 1976, pp. 144-166.

The transition from full-time education to employment is discussed. The planners of future teaching programmes must consider the needs of young people and their employers. The skill of effective working relationships as well as manual skills and production techniques must be considered. Courses need not consist exclusively of printed material. Spoken commentary, discussion, audio tape-cassettes and television programmes will continue to be useful additional resources. Students need to be treated as emergent adults and training programmes should reflect this. Programmes must provide recurrent opportunities for progressive achievement. Training of staff in appropriate teaching methods and counselling is essential and the team responsible for programmes should be supplemented by experts able to advise and deal with specific problems.

30. SADLER, P. "Social implications of automation". In *Proceedings of the institute of mechanical engineers,* Vol. 186, December 1972, pp. 141-147.

The links between technology and society and the ways in which changes in the one are likely to precipitate changes in the other are considered. The major ways in which technology influences the nature of society are identified and discussed and include: the *per capita* production of goods and services, the occupational structure, social organisation of the work unit, location of economic activity, size and structure of market and resource requirements. The occupational structure of society will change because of automation but training and retraining programmes will enable us to overcome problems associated with automation. There will be considerable transfer of power and influence to the educated professional and managerial class because of the high demand for knowledge inputs of automation. The form of society likely to emerge under the influence of automation is considered.

31. SCHULLER, T. *Education through life*. London, Fabian Society, 1978 (Young Fabian Pamphlet No. 47, 28 p.).

It is argued that life-long education has been a long-standing objective which demographic demand and particularly present employment trends now reinforce. Reasons why a coherent approach to the distribution of education requires much closer co-operation between the various parties and especially between the education and labour market authorities are presented. It is also argued that life-long education must not be seen merely as a response to economic demands, and the important benefits of lifelong education other than the economic benefits to the country of a skilled workforce are examined. A number of specific measures to facilitate lifelong education and improve Britain's education system are suggested which include a revision of admission policies to education courses, the development of introductory courses to help adults pick up the learning habit again, and the investigation and development of new ways of raising revenue for education and training.

32. SHANE, H.G. *Curriculum change towards the 21st century*. Washington D.C., National Education Association, 1977 (184 p.).

The book deals with a "reforming of the cardinal principles of education (and) proposes cardinal premises to guide curriculum developments that anticipate the 21st Century". A number of questions concerning the goals of education in the future are posed and the answers given to these by a panel of approximately fifty adults and eight-five young people are presented. A variety of curriculum innovations which are suggested by the new cardinal principles and premises which arise out of the panellists answers are described. Possible future changes in the world which are suggested by the panellists relate to the greater complexity facing society which results from technological breakthroughs, development of alternative energy sources and changing concepts of work and leisure. The "work ethic" and the need for vocational training are also discussed. Suggestions for curriculum change are given and two major innovations are discussed. One is a proposal for "seamless lifelong educational continuum" and the second is a proposal for developing the school into a "personalised learning centre".

33. SIMPSON, J.A. *Today and tomorrow in European adult education*. Strasbourg, Council for Cultural Co-operation, 1972 (223 p.).

The existing and likely future concerns of adult education in Western Europe are discussed. Schools and universities have attempted to meet the challenges of modern society which include industrialisation, urban development, the information explosion, and the growth of the economy. Adult education, however, has generally remained poorly supported economically and administratively, although the signs are favourable for expansion in this field in the future. The whole range of provision for adult education is discussed including resources, curricula, research and technology, new demands and new attitudes.

(Abstracted from IIEP Bibliography, Paris, 1978.)

34. WALLACE, W. "Universities and the future of Britain". In *The Times Higher Education Supplement*, 3.3.78.

The need to finance universities adequately to take account of the growing population of eighteen-year-olds going to university and the expanding intake of mature students is discussed. Adequate finance is necessary for the cultivation of continuing education and for the lengthening and reshaping of existing university courses.

Universities and industry must co-operate closely to bridge the gap between the over-specialised supply of graduates and the over-specialised demands of industry. The "spirit of innovation" borne by graduates and the substantial amount of pure and applied research carried out by them are important contributions to Britain's future. Ways of ensuring the continuance and growth of major research undertakings are suggested.

35. WHISTON, T.G. "Education and training for the less academic young person in relation to ongoing social and technological change: a brief overview". In *Report of a Conference on provision to meet the needs of less academic students between the ages of 16 and 19*. Wokingham, Berks., Southern Regional Council for Further Education, 25 June 1979, pp. 1-10.

The paper reviews the difficulties and possible educational policies which might be explored in relation to the diminution of unskilled employment opportunity (which may be accelerated by ongoing technological change). The paper distinguishes between labour-intensive mechanised industries which predominate at present and the subsequent labour release from fully automated industry. In directing and planning for future labour take-up it is suggested that an increasing attention to social skills and communication skills is desirable.

36. **WHISTON, T.G.** "The development of education: its technological and social dimensions". In R. Avakov (ed.), *The future of education and the education of the future*. Paris, IIEP, 1980, pp. 319-340.

The major technological and industrial developments which may operate over the next decade and some of the problems these may pose for educationalists are outlined. The problems facing developed and developing nations and the policy options available are treated seperately. With respect to developing nations there is some short discussion of the differing educational requirements of labour-intensive and capital-intensive socio-economic routes.

37. **WHISTON, T.G.** *Education, workstyles and social development: a mismatch of abilities*. Paper given to 139th Annual Meeting of the British Association for the Advancement of Science, September 1977, Aston University, England (22p.).

The relationship over the last century between an increasing educational input into society and an hypothesised steadily increasing "de-skilling" component in the industry due to rationalisation and technical change is examined. An increasing mismatch between educational output and industrial demand is suggested, which must be viewed in the context of a further "mismatch", that of the intellectual under-optimisation of a large proportion of society due to unchallenging educational systems. The social consequences of these two forms of mismatch and the implications for future educational and industrial policy are examined for a number of scenarios.

WHISTON, T.G. See section 5, Nos. 224, 225.

38. **WILLIAMS, THE RT. HON. S., M.P.** "Science and education" (1st Priestley Lecture). In *Chemistry in Britain*, Vol. 13, No. 12, December 1977, pp. 451-454.

There should be closer consultation between industry and science teachers. It is important to attract enough people of the right calibre to study engineering and technology in Britain. The fact that society has not yet accepted the idea of women as engineers and technologists is considered. The government's attempts to try to give a greater degree of standing and status to engineering and technology are discussed. The plan of the Royal Society to encourage young scientists by giving funds directly to teams working in interesting new fields of science even where these teams cannot become an established part of an existing university department is seen as an encouraging one. The question of why Britain seems so good at technological innovation and yet relatively unable to translate this into a direct impact in terms of industrial product is discussed. A certain alienation between education and industry is suggested as a possible reason.

II. Society, technology and education

39. **AUSTRALIAN ACADEMY OF SCIENCE, SCIENCE AND INDUSTRY FORUM.** *Obstacles and aids to innovation: principal points made in the papers delivered at the seventh meeting of the Science and Industry Forum, 28th Feb. 1970.* Canberra, April 1970, 54 p.

A number of marketing and technical research and development problems which account for the failure of potentially successful innovations are identified and discussed. The importance of the role played by top management if innovations are to be successfully implemented is stressed. A variety of aids to innovation are discussed, among them the importance of industrial education to demonstrate the benefits of research.

AVAKOV, R. See Section 1, No. 1.

40. **BARRON, I. and CURNOW, R.** *The future with microelectronics.* London, Frances Pinter (publishers) Ltd., 1979 (243 p.).

The authors discuss the effects of the ongoing microprocessor technology on industry and commerce with its wider major social, employment, institutional and structural change effects which may require major social, educational and training policy changes.

41. **BASIL, D.C. & COOK, C.W.** *The management of change.* London, McGraw-Hill, 1974 (243 p.).

This book considers the origins of change, traditional responses to change and strategies for change responsiveness. The authors identify and discuss some of the major factors which obstruct innovation. One of the factors dealt with is labour resistance to changes in methods. The book examines the work of a number of researchers, e.g. Burns and Stalker, Hage and Aiken, and discusses new findings regarding what characterizes organizations which are responsive to innovation and technical change. The importance of the role of management is stressed.

42. BECHER, T. and KOGAN, M. *Process and structure in higher education.* London, Heinemann Educational Books, 1980. (For an edited extract of this text, see *The Times Higher Education Supplement*, 2.5.80, p. 12.)

The authors consider how institutions adapt courses to conform with shifting values and modifications in the external environment. They consider six different patterns of change: in overall rationale; in curricula emphasis; in course structure; in disciplinary perspective; in teaching practice and in assessment techniques. In an engineering context, they argue that "The obligation to introduce 'engineering in society' courses has been strongly pressed by the professional engineering institutions, but it reflects a wider demand on the part of employers that graduate engineers should have certain qualities beyond the narrowly vocational skills and a narrowly technocratic outlook".

43. BESSANT, J.R., BROWN, J., DICKSON, K., and MARSH, J. *The impact of microelectronics: a review and bibliography.* London, Frances Pinter (publishers) Ltd., 1980 (200 p.).

Consideration and assessment of the potential and actual impact of microelectronic applications in both manufacturing and service industries is the focus of the study - including such factors as employment, demographic issues, managerial and labour attitudes and organisational matters.

44. CARNOY, M. *Education and employment: a critical appraisal.* Paris, Unesco: International Institute for Educational Planning, 1977, 91 p. (Fundamentals of Educational Planning, No. 26.)

The idea that more education in the labour force is a solution to high rates of unemployment in low-income countries is examined. Both the existence of empirical evidence and the logic of connecting formal and informal education with fuller employment are questioned. Alternative theories of economic development and labour markets which the author argues are the fundamental bases of understanding the employment problem are analysed and discussed in relation to the role of education in the development process. He attempts to show that different models lead to completely different results for employment policy. It is concluded that full employment is a political issue more than an economic one and that increased political power among workers and employees is the key to reducing the unemployment rate. Policy measures for full employment are suggested in the light of these conclusions.

45. **DEPARTMENT OF INDUSTRY.** *Industry, education and management: a discussion paper.* London, Department of Industry, 1977 (40 p.).

A number of areas are considered in this paper, including the qualification and supply of British managers, women and management, industry's poor image, incentives and differentials, and insdustry's use of graduates. The influence of the education system and its important role in industrial performance is also discussed. Schools and companies should be more aware of the schemes and facilities available to promote better understanding and effective co-operation. There is also a need for an adequate output from the schools of pupils educated to a sufficient level in mathematics and the physical sciences. Reasons for any shortfall in the quality and quantity of mathematics and scientific study in schools are given. Suggestions are made for improved careers guidance and education which have an important role to play. Institutions of higher education, the bodies supporting them and all those who work in this area must do everything they can to provide courses which are not only satisfying to students but which meet the needs of manufacturing concerns. Teachers, managers and trade unions need to develop greater and more frequent exchange of ideas between manufacturing companies and individual educational institutions.

46. **DICKSON, K., & MARSH, J.** *The microelectronics revolution: a brief assessment of the industrial impact with a selected bibliography.* Occasional Paper, Technology Policy Unit, University of Aston in Birmingham, December 1978. 87 p. (including 40 pages annotated bibliography).

The paper provides a brief outline of the history and manufacturing processes of microelectronic components together with their major computing and engineering applications.

The paper then considers non-technological factors influencing the rate of diffusion of microelectronics, for example, economic issues, managerial and labour attitudes, organizational influences and employment factors. This is followed by an assessment of the likely social impacts of computer-aided manufacture and of the possible future patterns of employment.

The authors suggest that "the present make-up of employment skills will be (another) factor to influence the introduction of microelectronics ... and that the shortage of suitably skilled personnel will inhibit the rate of introduction of computing systems, and it seems reasonable to assume that this will apply equally within manufacturing. The mismatch between present existing skills and future requirements, as well as the time-lag necessary to rectify this mismatch, will be significant influences. The degree of influence will be dependent somewhat on future government policy as to education and training for these new skills."

47. FORESTER, T. (ed.). *The microelectronics revolution*. Oxford, Basil Blackwell, 1980 (560 p.).

This book is a collection of short papers by several authors. It consists of three parts: Part One, the Microelectronics Revolution, which includes discussion of microelectronics technology, the microelectronics industry and applications of the new technology; Part Two is concerned with economic and social implications - with the impact on industry and the office, and with consequences for employment and industrial relations; Part Three, the Microelectronics Age, is concerned with broad social, political and philosophical implications. Each Part is followed by a guide to further reading.

48. FREEMAN, C. *Government policies for industrial innovation*. The Ninth J.D. Bernal Lecture, Birbeck College, London, 1978 (18 p.).

Micro-processors are extremely small, extremely reliable and extraordinarily cheap. The micro-electronic revolution is far more significant for the entire British economy than aircraft development or nuclear power, which constitute the largest part of government-financed R and D activities. Education and training are included in an outline of some of the main elements which could form the basis for a national strategy. Shortages of skilled people in computing and electronics are likely to become more acute. Wholehearted acceptance of the micro-processor revolution will be impossible, or will be accompanied by a great deal of misery and insecurity, unless there is greatly increased provision of re-training facilities and post-experience education, accompanied by resolute policies to secure a return to full employment.

49. GULBENKIAN FOUNDATION. *Broadcasting and youth*. London, Calouste Gulbenkian Foundation, 1979 (138 p.).

(This results from a study commissioned by the BBC, the Calouste Gulbenkian Foundation, the Independent Broadcasting Authority and the Manpower Services Commission.) The report, the work of a joint study group from the above authorities and deriving in part from the MSC's Report *Young people and work*, concentrates on the role that broadcasting both within the formal and non-formal education sector can significantly play in the education and training of young adults, particularly the unemployed and disadvantaged, and in relation to ongoing socio-technical change and reduced opportunity for employment.

50. HEYWOOD, J. "Factors influencing attitudes to technology in schools". In *British journal of educational studies*, Vol. 26, June 1978, pp. 137-149.

The conventional wisdom of the period 1945-63 regarding national prosperity and education for a technological society and the general response of schools and industry to this wisdom are discussed. Possible educational responses to the need for manpower in industry are discussed and it is argued that there is a need for an investigation of the relationships between pupils' perceptions of the job market and career choice. Shortages of manpower in particular sections of industry and extended education mean that the whole area of training and education for the 16-19-year-old groups must be re-examined in great detail.

51. HEYWOOD, J. *New patterns of course and degree structures*. Strasbourg, Council for Cultural Co-operation, 1973 (43 p.).

This report considers curriculum reform with particular reference to the evaluation of systems and curriculum. The purpose of the report is to reveal trends and indicate further research and action and problem areas for future study at national level. Among the topics discussed are the relationship between education and work, the practical needs of industry at the higher technical level and flexibility and diversity in higher education. One of the conclusions of the report is that the problem of recurrent education is most in need of research and discussion.

HUTCHINS, R.M. See Section 1, No. 15.

52. JAHODA, M. *The education of technologists*. Social Science Paperbacks: London, Associated Book Publishers, 1967 (226 p.).

The text is based on a three-year study of the "sandwich" process in higher education and examines the experiences of students, college staff and training officers in collaborating firms in order to define more accurately the conditions conducive to successful learning and development.

The findings and discussion are particularly relevant to the improvement and expansion of technical education.

53. KLUCHNIKOV, B.K. "Reflections on the future development of education". In R. Avakov (ed.), *The future of education and the education of the future*. Paris, IIEP, 1980, pp. 137-146.

The study which is being undertaken by Unesco on future trends in the development of education in the 1980s and 1990s is discussed. This will be Unesco's contribution to devising strategies for the New International Economic Order and its participation in the United Nations' Third Development Decade. One of the purposes of the study will be "to explore prospects in the development of education during the two coming decades and to outline priorities for international co-operation in education." The aims of the study and possible methods of work are outlined. The major themes of the study and a provisional list of themes are presented for consideration, including the effect scientific and technological advancement will have on education.

54. KRISHNAMOORTHY, C.S. "The educational explosion and its effects on the composition of scientific and technical manpower". In *Manpower journal*, (New Delhi) Vol. 9, No. 4, Jan-March 1974, pp. 105-119.

The increase of university graduate manpower in India since 1950 is considered. The impact of the expansion of technical education which has occurred on the occupational structure of technical and scientific personnel is discussed. Statistical tables are given to illustrate the arguments.

(Abstracted from G. Psacharopoulos, Education and work: an evaluation and inventory of current research. Paris, IIEP Working Paper, 1978.)

55. LECARME, O., & LEWIS, R. *Computers and education*. North-Holland, Elsevier, 1975.

Comprises selected proceedings of the IFIP (International Federation for Information Processing) Second World Conference on Computers and Education. The topics dealt with include organizational implications, computer-aided instruction, and the likely side-effects on society arising from this form of education.

56. LUTZ, B. *The responsibility of educational policy and the so-called needs of the employment system - some facts and critical reflections*. July 1977 (29 p., roneo). (Available at S.P.R.U. Library, Sussex University.)

The idea that the relationship between the education system and the employers is a simple supplier-customer relationship is argued against. The results of a comparative study of German and French industrial companies are presented and the close link between the respective national employment structures and the respective education and training systems is demonstrated. The results of the study are explicable only if it is accepted that employers are able to guarantee profitable industrial and productive processes using employees who have been qualified in quite different ways and that the education system has a considerable effect on the development of the employment structures. The implications this study has for the debate on vocational training in the German Federal Republic are discussed. The present practice of educational and training policy is criticised. A strengthening of the vocational system of education and training is of major importance and of "long-term significance".

57. **MADDOCK, I.** *The future of work.* Paper presented at Symposium on Technology Choice and the Future of Work, 22 November 1978, British Association for the Advancement of Science and the Intermediate Technology Development group (18 p.).

Major forces are influencing the pattern and scale of work in developed countries. These include the technological explosion and the mobility of technology. The effect these factors will have on the developed nations and the future pattern of work are considered. The impact of the micro-electronics revolution must be considered: as micro-electronics is "the most remarkable new technology ever to confront mankind." While we cannot predict the precise outcome of these influences, there is need for flexibility, adaptability and a widespread realization that profound change is inevitable. The areas of particular concern are: change in job opportunities, polarization of the workforce, de-industrialization and de-humanization. The liquidation of the Empire must also be taken into account by Britain for it has had and continues to have a profound effect on her economy. It is of vital importance to shed outmoded techniques and attitudes. The future role of both government and the educational system are discussed. The objectives which must be borne in mind when shaping the education system for the future must be flexibility, re-education in new skills and additional knowledge and education for personal satisfaction and responsibility.

58. **MESHEL, Y.** "The social role of the unions". Chapter 12 in *Technological change and human development*. Ithaca, New York, New York State School of Industrial and Labour Relations, Cornell University, 1970, pp. 319-330.

Discusses the major problems that confront workers as they try to meet the new demands of technological change. The difficulties arising when older, less educated workers work side-by-side with younger workers who have acquired a higher level of technological sophistication are examined. Public and private programmes which can help older workers meet the skill requirements of new technologies are considered. Only by concentrating on both the social and economic aspects of technological change can a solution be found to the confrontations which arise from the introduction of technological change.

59. MUNDY, J.A. "Science and technology in schools and working life: are we aiming in the right direction?" In *Comparative education,* Vol. 14, No. 2, June 1978, pp. 109-120.

The steady growth in unemployment in Europe, particularly among young people, is a serious problem. Improvement of the teaching of science and technology in schools together with more careers guidance and counselling could lead to a blossoming of industry and a fall in unemployment. The nature of reforms now being undertaken to mitigate the effects of unemployment among young people and the accompanying pressures on education systems is examined. The author points to weaknesses in these reforms and suggests that such changes may be short-sighted and possibly dangerous. Such reforms ignore: the political and ethical issues inherent in the development of science and technology; the increasing political and self-awareness of young people; developments in the teaching of science and technology and the problems for the management of curricula in relation to these issues.

60. NATIONAL ACADEMY OF ENGINEERING. *The process of technological innovation.* Washington, D.C., National Academy of Science, 1970 (103 p.).

Considers how the process of technological innovation is best motivated. The process depends on many more factors than the mere generation of scientific and engineering information. There appears to be insufficient understanding of the social and environmental factors that influence management and government. Factors facilitating innovation are discussed in the light of Dutch, Japanese and United States experience. The role of government in promoting technological innovation is examined using the case of France as illustration.

61. PARSONS, S.A.J. *The framework of technical innovation.* London, Macmillan, 1968 (196 p.).

Factors contributing to technological innovation are considered. British technical progress to date and the role of industry and government in technological innovation are examined. The communication of ideas, the functions of the Research Councils, the channelling of money towards innovation, and educational and manpower problems are discussed. Recent developments in higher educational policy, the Robbins Committee Report, technical education and the Industrial Training Act, 1964, are also examined.

62. PAVITT, K. (ed.). *Technical innovation and British economic performance*. London, Macmillan Press Ltd., 1980 (353 p.).

Most of the seventeen contributors work at The Science Policy Research Unit, University of Sussex. The basic theme of the book is that differences amongst firms and countries in their capacity for technical innovation have a significant influence on international competitiveness, economic growth and living standards. Several of the chapters relate to technical change and education. In particular, a chapter on Britain's Industrial Performance 1850-1950 by W. Walker traces back deficiencies in British technical education to the nineteenth century. In a chapter on British Attitudes to Engineering Education, A. Albu concludes that lack of demand by employers has been responsible mainly for the low status, pay and education of British engineers. Engineering had been taught more as an academic than as a vocational subject. N. Swords-Isherwood compares British management with management in other countries and suggests that technical expertise and excellence in engineering are not so highly rated in the United Kingdom or USA as in other advanced industrial countries. R. Rothwell concludes that the root of many of the problems of British management is lack of professionalism. "While much of British industry has been run by managers possessing few, if any, formal technical or managerial skills, our major competitors' industries have been controlled more often by trained managers possessing a range of such skills."

63. PEARSON, A. "Contract Research." In *Chemistry in Britain*, Vol. 12, No. 8, August 1976, pp. 248-251.

The use by industry of the research facilities of universities is examined. The findings of a survey of 22 organizations showed that the majority used universities for contract research, although only to a small extent. The comments of the organizations about the use of educational institutions for research are discussed. The importance of sponsoring research as a necessary part of ensuring that new technology is effectively transferred to the manufacturing industry was specifically mentioned. The findings of a survey of 14 university directors of industrial liaison which included questions about difficulties encountered and reasons for development are also discussed.

64. PYM, D. "The misuse of professional manpower". In D. Pym (ed.), *Industrial society: social sciences in management*. Harmondsworth, MIDDLESEX' Penguin Books, 1968, pp. 82-111.

The misuse of professional manpower in industry is widespread. A number of features of industrial organization which contribute to this misuse are examined. Educational institutions contribute to one important aspect of misuse: because of the process of specialization, many professionals are unable to apply their skills to a wide enough range of industrial tasks.

65. SCIBERRAS, E., SWORDS-ISHERWOOD, N., & SENKER, P. *Competition, technical change and manpower in electronic capital equipment: a study of the U.K. minicomputer industry*. S.P.R.U. Occasional Paper No. 8, Science Policy Research Unit, University of Sussex, September 1978 (146 p.).

Output and growth of the minicomputer industry in the United Kingdom have been constrained by shortages of experienced programmers and design and systems engineers. The general tendency to centralize major management functions in the United States diminishes requirements for highly qualified managers in the U.K. Minicomputers could have very important down-stream effects on other sectors of the engineering industry as they diffuse rapidly into such areas as process control, office equipment and telecommunications. An understanding of this sector, therefore, provides an insight into developments and implications for other diverse and important sectors.

66. SENKER, P. "Small firms struggle to buy N.C. machines for the wrong reasons". In *The engineer,* Vol. 247, No. 6402, 7 December 1978, pp. 45-48.

Small firms manufacturing precision press tools are reluctant to invest in numerically-controlled machine tools which would enable them to economize on the use of scarce resources of skilled labour. This reluctance is due to the traditional attitudes of owners and managers of toolmaking firms who are unwilling to make the changes which would enable them to take advantage of the increased productivity of advanced technology.

67. SMITH, R. *The educational needs for a competitive British society* (The Chairman's Lecture). London, The Stock Exchange, 23 November 1976 (18 p.).

Educational requirements for a more competitive British Society are examined. In particular the process of higher education provided by British Universities and polytechnics is considered.

New recruits into industry from the schools sometimes do not have the basic tools to do the jobs that are required and many of the best-trained students have no desire to join industry. The British education system is not equipping schoolchildren adequately and industry is not attracting enough of the ablest people. Higher education is one of Britain's major industries and requires regular injections of capital financed by society to maintain and improve its performance standards. It is desirable for higher education to take regular soundings of its efficiency so that the community which provides these financial resources may assess the true value it secures from its continuing investment. The difficulties of achieving the appropriate balance in student teaching between a concern for high education standards on the one hand and a planned exposure to the challenges of commercial and industrial life on the other is discussed. British society is not setting sufficient resources aside to ensure that increasing numbers of scientists and technologists will become available for professional management to achieve higher operating performance standards and to maintain a higher level of employment for the national labour force in the very late 1970s. Suggestions are made for building bridges between university staffs and industry.

68. STONIER, T. "A profile of the post-industrial society". In R. Page (ed.), *Strategies for change in a technological society*. Conference Report, Bath University, 20 December 1977, pp 4-9.

The cultural discontinuity which has occurred over the past twenty years is examined. The Electronic Revolution is seen as at the heart of the present transition. The basic characteristics of the post-industrial economy are identified and discussed and the place and form of future education is considered. Education is essential for economic growth; any country which cuts its expenditure on education is engaged in short-sighted economies. Britain should be training more sophisticated operatives, people who are not only trained for a specific skill but who also have a much broader sense of the world in which we live. The most important single resource of a nation is the skills and knowledge which its people possess. A distinction must be made between the need for improved technical education and the requirements for general education which leads to much more sophisticated and advanced knowledge systems and an understanding of the problems of society. Future education systems are discussed and the directions in which the author would like to see education move are presented. "The trick in acheiving a smooth transition is to understand where we are going and to look for economic doctrines relevant to the twenty-first century, not to the nineteen-thirties."

69. SWORDS, N. *Attitudes to changes in technology and work structure in the engineering industry.* (Final Report). London, Social Science Research Council, 1975 (29 p.).

Most of the assembly-workers interviewed showed effective up-to-date knowledge of some of the widely discussed experiements in industrial re-organization. They had coherent attitudes towards technical changes at their own workplace based upon cogently reasoned beliefs, whether well-founded or not. They were able to make realistic suggestions about effective re-organization of the work environment, including suggestions for technical improvements. If the image of workers as passive recipients of technical change continues to predominate, innovation processes may be encouraged which fail to take into account the dynamic participation of the workforce, whether as an actuality or as a potentiality. Such failure would give rise to difficulties; it would tend to sacrifice possible production benefits and it could mean that changes introduced by managements may be rendered less efficient by the adaptations of the work process instituted by the workforce informally. Further research could provide more conclusive evidence on the interaction between technical change, social organization and attitudes on the shop floor.

70. SWORDS-ISHERWOOD, N. & SENKER, P. "Social implications". Chapter 2 in G.B. National Engineering Laboratory, *Automated small batch production, technical study*. East Kilbride, National Engineering Laboratory, 1978, pp. 19-64.

This contains a report on a comparative study of resistance to automation in machine-shops in West Germany and Britain. Management resistance was found to be more important than worker or trade union resistance in both countries. There was greater resistance in Britain than in West Germany, primarily because of the worse organization, training and education of British management.

TIMES EDUCATIONAL SUPPLEMENT. See Section 3, No.142.

71. VAIZEY, J. *Education for tomorrow*. Harmondsworth, Middlesex, Penguin Books, 1970 (120 p.).

The author considers the importance of education for a country's future and places emphasis upon several institutional changes which he considers important in relation to social, economic and industrial development. Amongst these "greater equality of opportunity, more teachers, increased higher education, modern teaching methods, a balanced partnership between Ministry, Local Authority, teachers and parents" are considered to be vital.

72. VENNING, P. "The race to train the brains that work the future". In *The Times Educational Supplement,* 20.10.78, pp. 11-12.

The importance of education's response to the micro-processor revolution is considered. Britain could miss out on many of the benefits of the electronics revolution if her education and training system fails to produce enough skilled people. Already there is a shortage of engineers and technologists; more vocational training will become essential. Fairly substantial changes at all levels of the education system must be undertaken to cope adequately with the new technology. This technology may have an effect on schooling itself. Possible effects of chips on educational technology are examined. Measures are proposed to ensure an adequate supply of people with the appropriate vocational qualifications and technical information. In the long-term the education system may have to prepare young people for a drastically different society.

WEINBERG, E. See Section 3, No. 147.

73. WELCH, F. "Education in production". In *Journal of Political economy,* Vol. 78, No. 1, Jan-Feb 1970, pp. 35-59.

Reasons for the rates of return to high-school and college education remaining constant or increasing rather than decreasing with the large increase in the percentage of the population receiving more education are investigated. Education may allow for factor adjustment to changing conditions and enhance the ability to innovate. A technology gap exists between available technology and that understood and in use. Better-educated people can take more advantage of available technology than has been the case to date and can thus be more productive. Evidence from the agricultural sector is presented, and the fact that college-educated people seem to be more productive is discussed.

74. WOLFBEIN, S.L. "The pace of technological change and the factors affecting it". In S. Marcson (ed.), Automation, alienation and anomie, New York, Harper and Row, 1970, pp. 53-78.

A taxonomy of technological change is presented. The pace of technological change and factors in the management decision to automate are considered. Manpower effects of and adjustment to automation are discussed. Attrition and lay-offs due to automation pose a real threat to the labour force which can be eased by higher levels of economic growth. Private and public programmes to facilitate relocation and retraining are essential.

III. Technological change, training and retraining

75. ABBOTT, W.L. "Beating unemployment through education". In *The Futurist*, Vol. 12, No. 4, August 1978, pp. 215-221.

Perpetual retraining is necessary because of technological innovation. Older workers are most disadvantaged. Community colleges have been largely successful at providing a variety of educational courses, retraining and work-preparation schemes which have proved popular with labour, management and the U.S. Department of Labor. However, the danger of training people to meet the needs of the employer at the expense of the needs of the individual worker must not be ignored. A Swedish innovation known as the "study circle" is worthy of attention as a partial answer to worker obsolescence. A combination of the study-circle idea and the community college is advocated as a method of dealing with the problem.

76. AGASSI, J.B. "Women who work in factories". In *Dissent*, Vol. 19, No. 1, Winter 1972, pp. 233-279.

The impact of automation on the female industrial worker's position in backward and low-skill industries is analysed. There is a need for a campaign for resolute upgrading of technology, demanding guarantees for the training of women employees in the new more skilled jobs. New automated industries are creating new jobs but female workers are being largely ignored because they generally possess inferior skills and are concentrated in jobs demanding little training. The importance of equality, day-care services and community services are discussed and suggestions made for changing public policy.

77. ANDERSON, A., and HERSLEB, A. (Electronic Computers Sector Working Party Manpower Sub-committee, National Economic Development Office). *Computer Manpower in the '80s*. London, HMSO, 1980.

The report suggests that the spread of computer technology in Britain during the next decade will be severely constrained by shortages of skilled manpower. British industry is already short of at least 25,000 people with computer skills. Computer suppliers and users will be in competition increasingly for available skilled personnel. There is a serious shortage of staff with skills in engineering, systems and software. The report makes several recommendations: employers could help relieve the situation through better manpower planning; the education system should introduce knowledge of computers at the formative ages; there should be a more effective focus for training in computer skills.

78. BARNETT, C. "Employment and technological change". In R. Page (ed.), *Strategies for change in a technological society*, Report of Conference held on 20 December 1977 at Bath University, University of Bath Science and Technology Education Centre in association with the Standing Conference on Schools' Science and Technology, 1977 (pp. 23-30).

The relationship between unemployment and technological change is examined. The proposition that technological development, although vital to economic survival in a trading nation, is leading to a decline in employment opportunities at least in the short to medium term is discussed. Some measures that may be taken at both national and regional level to tackle the problem of technological unemployment are suggested and critically examined. The measures discussed fall into two broad areas of approach: the "work-sharing approach" and the "job-creation approach". The importance of manpower planning is stressed and possible roles for Government agencies such as the Manpower Services Commission outlined.

79. BEISHON, R.J. "Ergonomics and automation". In D. Pym (ed.), *Industrial society: social sciences in management*, Harmondsworth, Middlesex, Penguin Books, 1968, pp. 218-243.

The effects of automation and mechanization on the kinds of skills required of the workforce in the fields of materials handling and processing, labour or physical energy and information are examined. The shift in types of skills required after automation are discussed. Maintenance and repair skills become of increased importance although the nature of the maintenance work does not greatly change; rather, anticipating and tracing faults becomes more important and more difficult. Optimum training strategies for maintenance crews are discussed and it is suggested that preventive crews should have training in aspects of plant behaviour and operation whilst operating crews should be used for some maintenance work, since this may improve their behaviour in emergencies.

80. BELBIN, E. and R.M. "Retraining and the older worker". In D. Pym (ed.), *Industrial society: social sciences in management*, Harmondsworth, Middlesex, Penguin Books, 1968, pp. 152-173.

Considers why older workers are often rejected for retraining and discusses ways in which difficulties encountered in the retraining of mature workers may be dealt with. The possible advantages of "slow-motion" training and discovery learning are considered and the problem of previous work-experience hampering the acquisition of new skills is examined. The difficulties of selecting suitable older applicants for retraining are also discussed.

81. BERG, I. *Education and jobs: the great training robbery.* Harmondsworth, Middlesex, Penguin Books, 1970 (200 p.).

Reasons why educational requirements for employment continue to rise in the U.S.A. are examined. The conviction held by employers that, by raising their demands, they will be more likely to recruit an ambitious, disciplined work force that will be more productive than workers with less schooling is considered. This analysis fails to support employer practices and convictions. Job requirements and educational achievements are also considered in relation to the effects of technological change. The theory that widespread technological changes in occupations are responsible for the demand for a more highly educated work force is critically examined. It is concluded that: "It cannot be argued helpfully that technological and related changes attending most jobs account for the pattern whereby better-educated personnel are "required" and utilized by managers". The reasons managers give in defence of educational requirements for employee selection are discussed in detail.

82. BRAVERMAN, H. *Labor and monopoly capital: the degradation of work in the twentieth century.* New York and London, Monthly Review Press, 1974 (465 p.).

This book represents an important attempt "to inquire systematically into the consequences which the particular kinds of technological change characteristic of the monopoly capitalist period have had for the nature of work and the composition (and differentiation) of the working class". The myth of the increasingly skilled labour force if refuted. The author points out an important dichotomy in much current literature. On the one hand, modern work is thought to require increasingly higher levels of education and training and the greater exercise of intelligence and mental effort as a result of the scientific-technical revolution and automation. On the other hand, there is mounting dissatisfaction with the conditions of industrial and office labour.

83. BURACK, E.H. & PATI, G.C. "Technology and mangerial obsolescence". In *Michigan State business topics*, Vol. 18, Spring 1970, pp. 49-56.

The underlying causes of the obsolescence of companies, individuals and society are considered and managerial obsolescence and ways to combat it are discussed. Manpower planning and development are vital in the area of managerial and staff responsibility. Companies should provide formal training and development programmes and ensure that these are used by their employees. Unions and management must together devise advanced plans to deal with changes in the nature of work requirements arising from technological change. A greater effort should be made by society through the education system to keep in tune with new scientific developments and their application.

84. BURACK, E.H. & SORENSEN, P.F., JR. "Manpower developments and technological change: some considerations for revised strategies". In *Journal of management studies*, Vol. 8, No. 3, October 1971, pp. 304-314.

Some of the consequences of technological innovation for manpower development and promotional opportunities are discussed. It is argued that full automation is generally accompanied by management placing more importance on formal educational qualifications than formerly. Giving as an example car assembly-line work, the authors argue that partial automation reduces promotional opportunities for lower-level employees.

85. BUSINESS EDUCATION COUNCIL. *A role for B.E.C. in post-experience business education*. London, Business Education Council, Summer 1978 (9 p.).

Factors pointing to the need for a new look at the provision of post-experience business courses are examined. Increased reliance on technological aids and the increased trend for the initially highly trained to assume responsibilities for the management of resources for which they will need appropriate post-experience education and training are discussed. Technological advances will lead to the need for retraining on shorter and shorter cycles in the service and business sectors as well as in manufacturing. Those likely to need post-experience courses are identified and a possible approach to providing such courses is outlined.

86. CABINET OFFICE, ADVISORY COUNCIL FOR APPLIED RESEARCH AND DEVELOPMENT. *Technological change: threats and opportunities for the United Kingdom*. London, HMSO, December 1979 (38 p.).

This Working Group Report attempts to identify the technological changes likely to have a significant impact on employment in the next ten to fifteen years and to assess the consequences for employment of these changes. Microelectronics, information technology, energy technologies, materials technology and biotechnology are considered most significant. The two major driving forces for technological change are considered to be market pull, for example rising energy costs, and technology push, for example microelectronics. The Report suggests "Technological change has considerable implications for the organisation of education and training. The demand for unskilled labour is likely to decrease, while the number of mentally demanding jobs will rise. The unskilled traditionally receive very little training after leaving school. The introduction of labour-displacing technology would be eased if access to existing training programmes were easier for the unskilled, but "speculative training" without a clear prospect of employment will have little attraction. The need is therefore for more retraining "on-the-job" or at least within the enterprise". The Report goes on to suggest that the balance between public and private training may need to be reconsidered; and that universities and polytechnics will need to respond quickly to changing demands.

87. CANADIAN ASSOCIATION FOR ADULT EDUCATION. *Manpower training at the crossroads*. Conference held in Ottawa, 27-29 January 1976. Montreal, Canadian Association for Adult Education, 1976 (1 vol.).

Collection of conference papers on manpower training and adult education in Canada. Employment policy and the Canadian manpower training programme are considered. Government-supported training is evaluated and its future prospects discussed. Present trends in higher education are examined and future trends considered. Other aspects of the subject are considered, including the role of paid educational leave.

88. CHERNS, ALBERT. "Automation: how it may affect the quality of life". In *New scientist*, 8.6.78, pp. 653-655.

The acceleration of automation threatens to lead to a further dehumanising of industry. It is possible however to design automatic systems which would enhance, rather than reduce, the need for human skill. The author argues that design of automatic systems should be a participative process. The progress of automation has been little affected by political and social comment during the past 25 years. He discusses technological unemployment and points out that different orders of automation displace different levels of work skills and demand different categories of new skills.

89. COLLINS, R. "Where are educational requirements for employment highest?". In *Sociology of education*, Vol. 47, No. 4, 1974, pp. 419-442.

Varying levels and types of educational requirements for employment are examined. The results show that educational requirements are highest in large, nationally-oriented, internally bureaucratic, service-oriented organizations with a high rate of technological change.

90. CROSSMAN, E.R.F.W. & LANER, S. *The impact of technological change on manpower and skill demand: case study and policy implications*. Washington D.C., Office of Manpower Research, Manpower Administration, U.S. Department of Labour, 1969 (1 vol., various paginations).

This considers the hypothesis that automation and technological change impose increased skill demands on manufacturing and service industries. This work is based on case studies of a variety of companies. The study found that there was little or no net overall tendency for the mean skill level of the workforce to increase with technological change. Declines in absolute labour demand were greatest for semi-skilled workers, the next greatest declines were for labourers, and skilled workers were the least affected. A bibliography is included.

91. DALTON, G.W. & THOMPSON, P.H. "Accelerating obsolescence of older engineers". In *The Harvard business review*, Vol. 49, No. 5, Sept.-Oct. 1971, pp. 57-67.

The private sector's response to recognising and dealing with the lowering age at which engineers' educational training becomes obsolescent are considered. Six technology-based companies were surveyed and the findings are discussed. In order to remain competitive, technically-based companies faced with increased technological innovation must close the gap between age and performance. Traditional retraining and refresher schemes are not adequate. In-plant transmission media - including closed-circuit T.V., videotaping and two-way picture-phone - are more effective. To avoid unnecessary productivity loss from older workers, managers must increase co-ordinations between available skill levels and job assignments. The movement towards younger and younger obsolescence is largely induced by companies' rigid performance-appraisal systems, lack of counselling, and insensitivity to the needs of older engineers.

92. DELACOURT-SMITH, LORD. "A trade unionist's view of innovation". In M. Goldsmith (ed.), *Technological innovation and the economy,* London, Wiley-Interscience, 1970, pp. 139-205.

The concern felt by the labour force about the effects of technological innovations is considered. Whilst a proposed technological change will raise questions for management regarding available skills, retraining, etc., the workforce is likely to view the change with a keener sense of anxiety. This anxiety stems from the fact that a technological innovation may change the whole nature of the work process familiar to the worker. Management's method for smoothing the transition should be to adopt a multivariate approach. Increased attention should be given to increased security and the quality of life. Also needed is a de-emphasis of specialized skills, which may become outmoded in a short period of time and a return to a more generalized education which makes adaptation to changing skill requirements easier. Joint consultation between management and labour is recommended as a way of alleviating future labour disputes over automation.

93. DEXTER, C.R. "The interaction of age and education as predictors of workers' orientations towards change". In M.R. Haug and J. Dofny (eds.), *Work and technology,* (Sage Studies in International Sociology 10), California, Sage Publications Inc., 1977, pp. 81-89.

The roles of age and education in accounting for attitudes towards change are examined. The author uses survey data collected from workers employed in five divisions of a major American firm manufacturing light machinery parts. Different types of organisational changes are discussed - changes in on-the-job activities, change in social setting in which work is carried out, and desire for self-initiated change or responsibility.

94. *ECONOMIST, THE*. "Electronic all-change". Vol. 266, No. 7018, 4-10 March, 1978, pp. 70-1.

The computer revolution based on micro-electronics will soon mean substantial loss of jobs. Examples of the impact of micro-electronics on different branches of both the manufacturing and service sectors of the economy are given. The impact of electronics on the kinds of skills in demand is discussed and the need for people to be able to work with computers is considered. The Department of Education in Britain has been studying how to teach schoolchildren "computer-speak". The potential benefits of such a labour-saving technology are emphasised. "A disadvantage arises from labour-saving technology only if governments try for too long to protect industries run under the old technology".

95. EUROPEAN COMMUNITIES. *From education to working life*, Bulletin of the European Communities, No. 12, Luxembourg, European Communities Publication, 1976 (63 p.).

The educational preparation and training of the young and school-leavers for employment in the European Community countries are considered. The report consists of a background analysis of the present situation and a resolution for a programme of action. Measures for local-level and national-level action are proposed concerning teacher training, vocational guidance, motivation and curriculum development. The educational opportunities for girls and migrants are discussed and the importance of the co-ordination of educational planning is stressed.

96. *EUROPEAN INDUSTRIAL RELATIONS REVIEW*. "West Germany's new vocational training scheme". No. 43, July 1977, pp. 16-17.

The first report of the new West German Federal Institute for Vocational Training is discussed. Firms must be further encouraged to maintain and expand their training facilities if the needs of a new technical age are to be met successfully. The role of the Institute and the measures taken are described and the new funding methods implemented to ensure adequate and appropriate training are presented. The measures taken have been successful but only continued financial aid from the *Länder* will make the stability and productivity of the West German economy secure in the future.

97. **FORESTER, T.** "The micro-electronic revolution". In *New Society*, Vol. 46, No. 840, 9 November 1978, pp. 330-332.

The possible effects of the micro-electronic revolution on British industry are considered. A brief explanation of the term "micro-electronics", a description of how "micro-processors" work, and examples of some of their applications are given. The official French government's report on micro-processors (the "Nova" report) is discussed. This report maintains that micro-processors will "wreak havoc" on the existing industrial structures by attacking jobs in the existing information sectors and by making many jobs in the manufacturing sectors obsolescent. The unpublished British Department of Industry report *Computers, systems and electronics* is also discussed, and an example given of the impact micro-processors have had on the mechanical-watch industry of Switzerland and Southern Germany. De-skilling and the need for the retraining of a reduced labour force were just two of the consequences. The need for the British Government to respond effectively to the challenge of micro-electronics is emphasised.

98. **FREEMAN, C.** *The Kondratiev long wave, technical change and unemployment*. Science Policy Research Unit, University of Sussex, January 1977 (29 p.).

In the early years of a new technology employment may be generated; after about a quarter of a century, new technologies and branches of industry are firmly established and their role as generators of new employment eventually disappears. Examples are given of labour-displacing technical changes now possible which result in mature, cheap and reliable technology. Major effects may be experienced by industries such as banking, printing, insurance, publishing, machine shops and many types of assembly.

99. **FREEMAN, C.** *Science and technology in the new economic context*. Paper on Unemployment and the Direction of Technical Change: Draft Prepared for the Working Group meeting on 3 and 4 November 1977, Paris, OECD, Directorate for Science, Technology and Industry, 1977 (31 p.).

Most industrialised countries' unemployment is now higher than in the 1960s. A number of the fast-growing industries of the 1950s and 1960s are now slowing down. A return to high levels of investment will reduce unemployment only if investment is sufficiently labour-intensive. Technical change, demographic change and lack of demands could lead to rising unemployment. Governments should increase their support for fundamental technology, fundamental science and exploratory development.

100. FRIEDRICHS, G. *Microelectronics - a new dimension of technological change and "automation"*. In the Club of Rome Conference "The Coming Decade of Danger and Opportunity", International Congress Center (ICC), Berlin, 31 January 1979 (27 p.).

The paper reviews within a German and European context the effects of technological change and automation upon skills and employment. The author is Head, Automation and Technology Department, German Metal Workers Union and Vice-president, National Productivity Agency (RKW). Under section (10) of the paper, a "new role for education", he emphasises the need for education which introduces a large degree of *flexibility* in relation to changing work patterns and varied work opportunity.

101. FYFE, J. *The economic and employment aspects of technological change*. Paper presented at Symposium on Technology Choice and the Future of Work, 22 November 1978, British Association for the Advancement of Science and the Intermediate Technology Development Group, pp. 76-95.

Recent and foreseeable technological developments and their possible implications for the future of employment are considered. The link between economic theory and technological change is discussed and an alternative approach suggested. Examples from specific industries demonstrate how the economic and employment consequences of technological change could be significant for particular industries.

102. GUILBERT, M. "Woman and work: the effects of technological change" In *Impact of science on society*, Vol. 20, No. 1, Jan.-March 1970, pp. 85-91.

While industrialisation has provided many new job openings for women, the work is still essentially of the same menial and poorly-paid calibre as that done before the spread of technology. It would appear from present evidence that the new technology of automation will not substantially change matters. The introduction of automation in a plant has tended to eliminate low-skill jobs filled by women, either creating unemployment or else displacing the holders to other jobs still requiring "the poorly-paid feminine qualities of patience and manual dexterity". The importance of providing vocational training for women at a high standard and in a wide range of subjects is emphasised.

103. **HAMMERSLEY, P.** "The Impact of Changing Technology". In *Computer Journal*, Vol. 23, No. 1, pp. 7-9.

Discusses changing skill requirements, computer team relationships and user relationships and their changes with technological developments.

104. **HARVARD UNIVERSITY PROGRAM ON TECHNOLOGY AND SOCIETY.** *Technology and work*, Research Review No. 2, Winter 1969 (47 p.).

Recent literature is reviewed with a detailed annotated bibliography concerning the impacts of technology on the occupational distribution of the labour force and on work patterns and skills. The public policy aspects of these changes are also discussed.

105. **HAVERLAND, E.M.** *Transfer and use of training technology: a model for matching training approaches with training settings*, Alexandria, Va., Human Resources Research Organization, 1974 (78 p.).

A model for the evaluation of training innovations in relation to specific training settings is discussed. The model was developed and tested by training managers and curriculum designers at several air force technical education centres in the U.S.A.

106. **HERMAN, A.S.** "Manpower implications of computer control in manufacturing". In *Monthly labour review*, Vol. 93, No. 10, October 1970, pp. 3-8.

The employment impact by skill and education level, of the introduction of computers to direct control of industrial production processes and manufacturing operations in six process industries is examined using a Bureau of Labor Statistics 12-plant case study. In particular, worker displacement, job modification, job creation and retraining efforts are considered. The main impact has been the modification of job duties within the plant leading to some job creation at higher skill levels but little net change either in employment or wage rate at the lower skill levels. Introduction of computers into the process industries is expected to continue, resulting in a gradual decline in the demand for labour, particularly at the lower skill levels.

107. **IVEY, L.T.** "Technological innovation in elementary industrial arts". In *School shop*, Vol. 29, No. 8, April 1970, pp. 104-108.

Describes a pre-vocational training scheme introduced into primary education by the Elementary Industrial Arts Project, Windsor, North Carolina, to help children in a poor rural area to adapt themselves to an environment of technological change. The teaching methods used are described and the importance of curriculum design and teacher training are discussed.

108. JENKINS, C., and SHERMAN, B. *The collapse of work*. London, Methuen, 1979 (182 p.).

This book argues that fundamental changes, indeed national employment crisis, in part due to the industrial and commercial employment consequences of the emergence of the technology of the microprocessor is leading to a "third industrial revolution". In relation to this changing technological era the authors (General Secretary and Director of Research of ASTMS - one of the leading UK white-collar unions) analyse what they consider will happen to the market demand and manpower requirements in a wide range of sectors. They argue that there is an enormous need to revolutionise attitudes to work and leisure - of which formal education programmes have a significant role to play.

109. KASSALOW, E.M. "automation and labour relations". In S. Marcson (ed.), *Automation, alienation and anomie,* New York, Harper and Row, 1970, pp. 278-293.

Public and private policy responses to automation up to the early 1960s are discussed, and in particular the adjustment of blue-collar workers in a number of mass-production industries is examined. Automation appears to be undermining the industrial and political strength of trade unions by diminishing the size of the blue-collar work force relative to the white-collar work force. Adjustment to automation involves a vigorous full employment effort. Public policies to aid the development of the supply of labour are also required, including retraining, general manpower programmes and education. The private responses to automation have already included relocation and retraining allowances, job security measures and early retirement.

110. KORSAKOV, E. "Technological progress and its effects on Soviet dock workers". In *International labour review,* Vol. 105, No. 6, June 1972, pp. 531-543.

The changing role of workers and the increase in production due to the introduction of modern technological equipment in the Soviet seaports are considered. The introduction of new machinery presented some problems for relatively unskilled cargo handlers but the systematic upgrading of pay-scales and education and training schemes for this section of the workforce resulted in a smooth transition to modern methods of handling cargo. The favourable outcome of this experiment has prompted the Soviets to expand the programme to other cargo-handling centres.

LARGE, P. See Section 1, No. 17.

111. LEE, J.W., & LANCASTER, J.W. "The maintenance training gap". In *Training and development journal*, Vol. 25, No. 11, November 1971, pp. 46-49.

Considers the changing demand for and role of the maintenance worker and discusses what will be the possible future skill-levels needed for a new type of maintenance worker. Industry must begin to train a new kind of maintenance worker because of the transformation of the blue-collared maintenance worker into a white-collared technician. Likewise, because it is predicted that new entrants will have at least three separate occupations during their lifetime, the training they receive should aim to give them a well-rounded, rather than a narrow background. Additional research on maintenance training and the maintenance function and additional empirical research in the area of maintenance-training effectiveness methods and problems are recommended.

112. LEIDER, R.J. "Mid-career renewal". In *Training and development journal*, Vol. 30, No. 5, May 1976, pp. 16-20.

This considers the phenomena of mid-career change when, during this transition period, many individuals are more carefully examining their goals and needs as they relate to present careers. It is argued that this has been made possible by the industrial and societal factors of mass-production, a higher standard of living and greater career expectations, technology and job obsolescence. All this stresses the need for life/career planning that causes an employee to carefully examine goals, values, skills and the related work environment.

MADDOCK, I. See Section 2, No. 57.

113. MANPOWER SERVICE COMMISSION. *Training for skills: a programme for action*. London Manpower Services Commission, 1978 (51 p.).

The occurrence of skill imbalances and the contribution of training to redressing these imbalances are examined. There is a diversity of need both between and within industries and an effective system for correcting skill imbalances and for improving employees' training opportunities must take this into account.

Factors other than inadequate training make filling vacancies with suitably trained people difficult and some of these factors are discussed. The history of government concern with and intervention in training in industry from the Carr Report to the 1973 Employment and Training Act is outlined and a description is given of the current range of training measures operating. An action programme to improve the amount and quality of training in skills needed by industry is proposed. A more flexible training response is needed for resolving skill imbalances. Recommendations include the encouragement of training and retraining opportunities for adults and the need for the form, content and duration of training to be based on satisfying both the individual's and industry's needs. Measures taken in Sweden, the Federal Republic of Germany and France in response to similar problems are discussed and what public measures might be developed in Britain to support industrial training schemes are considered.

114. McCAFFREY, G. "A labour view of technical and vocational education". In *Canadian vocational journal* (Ottawa), Vol. 6, No. 1, January 1970, pp. 12-15.

The inadequacies of the educational system in Canada and its role in helping to solve the increasing manpower problems resulting from technological change are analysed. The development of technical education and vocational training are also discussed.

115. McKIE, R. "Technician engineering degree courses urged". In *Times Higher Educational Supplement*, 7.4.78, p. 3.

A number of reports to the Finniston Committee are discussed. Imperial College reported that the important role of technician engineers must be recognised by introducing separate degree courses. Industry is criticized for its reluctance to release professional engineers to study for higher qualifications and thereby keep abreast of changes; without this Britain will be unable to use advanced techniques or exploit new developments. The Royal Institute of Naval Architects blamed industry for failing to develop a proper strategy towards the training and career development of engineers. The Society of Electronic and Radio Technicians emphasised that education and training are part of a single process and the qualifications procedure must include both.

116. **MANSFIELD, E., RAPOPORT, J., ROMEO, A., VILLANI, E., WAGNER, S., & HUSIC, F.** *The production and application of new industrial technology*. New York, W.W. Norton & Co., Inc., 1977 (220 p.).

The social and private rates of return from industrial innovations, the nature of the development process, the determinants of development costs, the relationship between innovation, development and size of firm and the organisational and strategic factors associated with probabilities of success in industrial research and development are considered. The determinants of the speed of application of new technology, including the effect of public policy, are also discussed. Empirical results are based on data obtained from hundreds of firms and organisations.

117. **MATHEWS, D.** *The relevance of school learning experience to performance in industry*. London, Engineering Industry Training Board, 1977 (137 p.).

The report examines the relationship between methods of teaching which craft and technical trainees entering the engineering industry experienced at school and their performance in the first year of their industrial training. The study was based on a sample of more than 1,800 first-year craft and technician trainees in 34 training centres throughout the country. It investigates the usefulness of craft subjects as a basis for acquiring the planning skills by craftsmen. It also discusses the effects of mathematics teaching at school on the performance of trainees and considers the importance of pupils motivation to learn maths. The report describes the instruction methods used in engineering training and suggests how these methods might be adapted to take advantage of trainees' previous learning experience. It looks in particular at innovative school methods and examines the appropriateness of the Engineering Industry Training Board's recommendation for craft and technician trainees with different types of educational experiences.

118. **MORTIMER, J.E.** *Trade unions and technological change*. London, Oxford University Press, 1971 (108 p.).

The role, strength and history of trade unions in England are surveyed with particular reference to the effects of technological change. A major recommendation is made for a private and public effort to enhance the training available to adults and juveniles so that the transition to a more technologically advanced society can be accomplished with the least human suffering.

119. **MUELLER, E., HYBELS, J., SCHMIEDESKAMP, J., SONQUIST, J., & STAELIN, C.** *Technological advance in an expanding economy: its impact on a cross-section of the labour force.* Ann Arbor, Michigan University, Survey Research Centre, 1969 (254 p.).

This work is based on a large study which made use of cross-sectional analysis to show the frequency of changes in machine technology and in what occupational and educational groups they occured. Individual chapters contain information on a number of related issues, including change in machine technology, change-over process to new equipment and impact of changes on perceived job characteristics and job satisfaction. The role of education in relation to technological change is also discussed in detail and an analysis made of cases where poor adjustment was made to technological change.

120. **NEW YORK STATE, DEPARTMENT OF LABOR.** *Manpower impacts of industrial technology.* Publication B-172, 1969 (96 p.).

The effects of technological change on the manpower and training needs of New York State industry were studied in a survey of 281 industrial situations. The survey aimed to provide information about the effects of factory and related technological change in displacing workers, in creating recruitment and training needs, and in altering the skills required of persons working on or in connection with industrial equipment during the period 1962-1966. The survey found that while the replacement of one type of machine by another was accompanied by upward skill changes in some cases and by downward changes in others, the number of no-change cases was numerically the most important.

121. **PEITCHINIS, S.G.** *The effect of technological changes on education and skill requirements of industry.* Research Report of the Technological Innovation Studies Program. Ottawa, Canada, Department of Industry, Trade and Commerce, Technology Branch, 1978 (272 p.).

Considers the impact of technological change on the sectoral distribution of employment in Canada and discusses the problem of determining the effects of technological changes on education and skill requirements. The report examines a variety of issues, including technological innovation and high-level manpower, electronic systems and educational requirements, and existing levels of education and industry requirements. Different approaches to adjustment to technological change are described and an overview of technological changes and their manpower implications in various industries is given. The results from the questionnaire used in the study are given and the report concludes that technological changes do not appear to create any serious manpower problems and the evidence indicates no problem regarding the effect of technological change on education and skill requirements. Employees seem to be able to adjust to new processes and the majority of organisations assist this through retraining programmes. A potential problem may be worker adjustment to future changes, which may be more far-reaching and require a larger increase in technical knowledge. The report ends with policy recommendations for dealing with this. An annotated bibliography is included.

122. PEPINO, L.F. "Occupational technology: an experiment in curricular flexibility". In *Engineering education,* Vol. 65, No. 8, May 1975, pp. 831-832.

This describes an Occupational Technology Curriculum designed to meet the widely divergent needs of individuals already employed in industry or business who desire to upgrade a present skill or acquire a new one. The curriculum is structured so that half of the credits required for the associate degree are free-choice courses and half are required-core courses.

123. PERLINE, M.M., & TULL, K.L. Automation: its impact on organized labour. In *Personnel journal,* Vol. 48, No. 5, May 1969, pp. 340-344.

Automation may be increasing the demand for unskilled labour while at the same time diminishing the need for skilled craftsmen. Collective bargaining is the only viable route available for labour to take as it attempts to ameliorate the problem caused by automation. Existing contract provisions which have been implemented by unions to offset the impact of automation are discussed.

124. PETCH, S. "The future pattern of employment". In *New scientist,* Vol. 78, No. 1106, 8.6.78, pp. 661-663.

While automation is likely to produce a rapid increase in unemployment if the British economy remains static, it poses far less of a threat to a growing economy. Increased automation will accelerate the outdating of traditional skills and some skills will be more affected than others. The way in which the educational system operates must be examined if new skills are to be nurtured. A great deal of attention and thought will be needed if Britain is to meet successfully her new education and training objectives.

125. PORTER, J. "The future of upward mobility". In *American sociological review,* Vol. 33, No. 1, February 1968, pp. 5-19.

This is the text of the 1966 Maciver Award lecture on the educational aspects of the need for upward social change to meet labour shortages resulting from technological change in the United Kingdom and the U.S.A. More highly-skilled workers and professional workers are needed. Motivation for upward changes in social status and cultural factors which affect the situation, and problems of the "brain drain", are also considered.

126. PRASOW, P., & MASSARIK, F. *A longitudinal study of automated and non-automated job patterns in the Southern California aerospace industry.* Springfield, Va., National Technical Information Service, 1969. (Vol. I, ongoing volumes).

It is argued that although automation has strong implications for society, the real problem is not the changes themselves but our failure to understand and adjust to them. Using data gathered from personal interviews with a random sample of employees of six major aerospace firms, this study compares automated and non-automated factory and office jobs in order to determine the effects of automation. By measuring the worker's ability and willingness to adapt to a changing environment, while considering his background and attitudes, the study provides findings useful for establishing public training and retraining programmes, as well as for revising vocational education programmes to meet changing needs.

127. PRASOW, P., & MASSARIK, F. *The impact of automation on individuals and jobs: a review of recent literature (1956-1967).* Vol. II, Los Angeles, Institute of Industrial Relations, University of California, April 1969.

No general conclusions are possible based on the findings of the studies reviewed. Research seems patchy, conclusions are tentative and results strongly debated. Conclusions on the effects of automation and the best means of adjustment depend in part on the way in which automation is perceived - evolutionary or revolutionary. Education must change significantly to enable people to adjust to change. Whether it must be broader, more comprehensive, more specialized and/or a combination of these must be investigated further.

128. PYM, D. (ed.). *Industrial society: social sciences in management*. Harmondsworth, Middlesex, Penguin Books, 1968 (463 p.).

A number of the essays in this collection consider various aspects of technical change and its effect on manpower. Several of the most relevant essays are included in this bibliography under the author's names: D. Pym, "The misuse of professional manpower"; K. Tilbey, "A technology of training"; D.H. Holding, "Training for skill"; E. & R. Belbin, "Retraining and the older worker".

129. REZLER, J. *Automation and industrial labor*. New York, Random House, 1969 (224 p.).

The effects of advanced technological change upon the industrial labour force of the U.S.A. are discussed. The three basic areas of the occupational life of the industrial worker examined are: his job, his relation to his union, and his relations with his employer. Some basic terms associated with automation are defined and a number of different aspects of the subject are considered in detail, including: the availability and job composition of employment; possible changes in job content and skill requirements; and the effects of automation on job satisfaction and mental health of the worker. Changes in the power relationship existing between management and unions, new issues that, as a consequence of automation, are emerging in collective bargaining, and novel approaches to collective bargaining that have been proposed by unions and management are discussed. Public policies on technological unemployment are examined and recent legislative action in the area of manpower is surveyed.

130. REZLER, J. "Automation". In J.J. Famularo (ed.). *Handbook of modern personnel administration*, New York, McGraw Hill, 1972, pp. 63.1-63.14.

Solutions to problems arising from automation and which personnel managers may face are discussed. The personnel manager has a major role to play in helping workers adjust to automation. Advance notice of impending change and continuing communication to reduce apprehension are within the scope of the personnel function. As automation affects the job content and composition of the workforce, personnel managers must anticipate manpower needs and arrange plans for the transfer and retraining of current employees and for possible unemployment which may result from the change. Automation will upgrade the functions of the personnel managers and will require them to update their training and education.

131. ROBERTS, D. "Chips, challenges and opportunities". In *New Scientist*, Vol. 78, No. 1106, 8.6.78, pp. 648-651.

If Britain is to be industrially competitive in the future, it is vital for the impact of present and future semi-conductor devices to be fully understood. An intelligent strategy must be applied to ensure both adequate access to the key technology and the necessary skills and investment to exploit it throughout industry. The various areas where one may expect continued improvement are discussed and include display technology, imaging devices, microwave device technology and optical fibre communication links. Areas where the new technology has had adverse impact on established industries and employment patterns are also discussed.

132. SADLER, P. Automation and europe. In *New Scientist*, Vol. 80, No. 1130, 23.11.78, pp. 597 and 599.

The relationship between employment and technological change is discussed. European countries will meet increasing competition from rapidly industrialising countries in the third world. The main factors which will affect employment in Europe in the future are identified. Possible responses will include: adopting labour-saving technologies in the industries most threatened, restructuring European economies in favour of high-technology industries and service industries, thus accelerating the decline of employment in manufacturing industries and the growth of employment in services. The extent to which education and training provision matches up to job opportunities will be an important factor affecting employment prospects.

133. SEEAR, BARONESS. "The place of training in reinvigorating the economy". The opening address to the 1977 biennial conference of the Industrial Training Research Unit in Cambridge. In *Industrial and commercial training*, Vol. 9, No. 11, November 1977, pp. 452-454.

The economic position of Britain and ways of improving it are considered. There is need to concentrate on high-value-added activities. The problem of conflict between long-term and short-term solutions to problems is discussed. Retraining to cope with technological change is essential even though it may seem to conflict with workers' rights to job security. Flexibility is an important key to improving the economic climate in Britain. Therefore, the kind of training needed is that which enables people to adjust to meet changing demands. The paradox of high unemployment and a shortage of skilled workers is considered. The NEDO report on the shortage of skilled workers is discussed and it is argued that the importance of skilled employees is such that Britain should build round the need for skilled people as an integral part of the whole economic programme. The relationship between education and training is considered. Basic changes are needed and school-based work education, followed by work-based continuing college or school educational opportunities, is suggested as one way of improving the existing situation.

134. SENKER, P., HUGGETT, C., BELL, M. & SCIBERRAS, E. *Technological change, structural change and manpower in the U.K. toolmaking industry*. Watford, EITB, 1976 (72 p.).

The report discusses the nature of technological change in toolmaking, and finds that important barriers to a rapid rate of technological change exist. The skills deployed in an organization depend on the organization's manpower, training and job design policies as well as on the organization's economic and technological characteristics.

It is suggested that the relationship between technological change and manpower is enmeshed in the interaction of a wide range of other factors and that the process in which they interact is open to choice by companies and other participants in the process.

135. SENKER, P. "Manpower and skill implications of technical change in the engineering industry". Paper presented to the Manpower Society Conference "The Challenge of Change", September 1979 (26 p.).

The author suggests that there is a fundamental misconception at the heart of neo-classical economists' analysis of the implications of technical change: that technical change arises from the outside and dictates a new pattern of manpower and skill deployment. Such an analysis also assumes that firms combine land, labour and capital in optimal porportions in order to maximise profits in the short run. Preliminary findings of empirical research on sectors of the United Kingdom engineering industry are discussed. It is concluded that whilst most successful firms aim to maximise profits in the long run, many United Kingdom engineering firms tend to pursue short-term goals, cutting back on innovation expenditures and training during periods of recession. British managements have generally employed insufficient people with the skills necessary for more successful competition on international markets. The United Kingdom engineering industry is grievously short of the skills necessary to select and implement appropriate technical changes.

136. **SENKER, P.** "Wanted: good training ... more education". In *The engineer*, 18 October 1979, pp. 40, 41, 46.

The author disputes the popular myth that the United Kingdom's engineering industry problems can be laid at the door of uncooperative workers and their trade unions. He suggests that more important reasons are that British managements have employed insufficient people with the skills necessary to implement changes necessary for more successful competition in international markets. Studies in the engineering industry are reviewed briefly and it is concluded that the engineering industry is suffering from failure to employ sufficiently well-trained engineers in both management and other functions. Examples are drawn from the television and forklift-truck industries to show that the advent of microelectronics reinforces needs for manufacturers to strengthen their technical staffs in all aspects of their businesses.

137. **SLEIGH, J., BOATWRIGHT, B., IRWIN, P. and STANYON, R.** *The manpower implications of micro-electronic technology*. London, HMSO (Department of Employment), 1979 (110 p.).

This is the report of the Manpower Study Group on microelectronics which was established by the Department of Employment in July 1978 in order "to examine the manpower implications of micro-electronic technology up to 1990". The extensive report, whilst being more cautious than many previous forecasts as to the manpower implications of ongoing technical change, makes two major recommendations: firstly, that "Britain has no option but to seek to adapt to micro-electronic technology at least as fast as (its) competitors" and secondly that the Department of Employment "encourages training organisations of all kinds to relate their training and retraining efforts more closely to the current and envisaged skill requirements of micro-electronics technology; and to pay particular attention to the problems of the relatively unskilled."

138. **STEIN, J.L.** "Manpower planning for displaced workers: evolution of private manpower planning in Armour's plant crossing". In *Monthly labor review*, Vol. 92, No. 12, December 1969, pp. 21-28.

Efforts to ameliorate the plight of workers affected by plant closures are examined. The extensive adjustment methods used, including pre-shutdown planning and continuing education, contractual benefits and job placement and training are described, and the effectiveness of these techniques is discussed. Pre-shutdown planning is vital to the success of a manpower adjustment programme.

For a number of reasons, continuing education programmes can be arranged; workers have time to retrain for other jobs; manpower agencies are able to inventory the skills and desires of the workers to be displaced and the alternatives and opportunities the community can offer. In general, pre-shutdown planning enables the adjustment to be made as efficient and humane as possible.

139. SWORDS-ISHERWOOD, N. and SENKER, P. *Microelectronics and the engineering industry: the need for skills.* London, Frances Pinter (Publishers) Ltd., 1980 (150 p.).

The text considers the changing technology and consequent skill and associated training requirements in a range of industrial and commercial sectors in the United Kingdom. The sectors are classified into production processes (assembly, automated batch production, welding); industrial sectors (the motor industry, forklift trucks, agricultural equipment, textile machinery, the machine-tool industry, welding equipment); electronics and telephone equipment (telephone equipment, televisions, minicomputers); and finally the office sector and the role of office automation on skills. The skill requirements arising from microprocessor applications in these sectors are then discussed.

140. TAVISS, I. & GERBER, W. *Technology and work.* Research Review No. 2, Program on Technology and Society, Cambridge, Massachusetts, Harvard University, 1969 (47 p.).

Reviews recent literature concerning the impact of technological change on the occupational distribution of the labour force and on work patterns and skills. Social and policy implications of technological innovation are considered and the effect of technological advancement on the occupational distribution of the labour force is discussed in reference to professional, technical, skilled, unskilled, blue-collar and white-collar workers. The question of whether skill levels are raised or lowered as a consequence of automation is also discussed. An annotated bibliography is included.

141. TECHNOLOGY POLICY UNIT. *Trade unions and new technology.* Technology Policy Unit, The University of Aston in Birmingham, November 1979 (33 p.).

This is a report of a Trade Union Conference on the use and impact of micro-electronics organised by the West Midlands Regional TUC and the Technology Policy Unit, Aston University, November 1979.

The report comprises meetings and workshop reports in relation to microprocessors, technical change and employment, including a description of the "TUC Education Programme on New Technology" (G. Poynter, TUC).

142. *TIMES EDUCATIONAL SUPPLEMENT*. "New jobs for old ... and the less able will be the first casualties". 20.10.78, p. 13.

The employment consequences of the microprocessor evolution are considered. While some jobs have been created by the development of the "chip", the automation of production will result in real job displacement and de-skilling of work. Increasing automation means some radical re-thinking of what may become two separate issues: the sharing of work and the sharing of income. The effects on female employment of micro-electronics are discussed and it is argued that regardless of the size of the reduction of jobs caused by this technological change, the nature of work and leisure will be radically different and this puts an enormous onus on the education system. Schools will have to do more than prepare their pupils for a new economic role. The possible responses the education system can make to this new situation are discussed, including the importance of teacher training and computer studies.

143. U.S. DEPARTMENT OF LABOR, BUREAU OF LABOR STATISTICS. *Occupational manpower and training needs: information for vocational counselling and planning for occupation training.* (Bulletin No. 1824.) Washington, D.C., U.S. Government Printing Office, revised 1974 (109 p.).

Presents projections of the 1985 manpower requirements of 240 occupations for which considerable training is most often required or desirable and which will comprise an estimated 70 million workers or two-thirds of the civilian labour force at that time. Projections of occupational requirements for broadly-defined occupational groups through the mid-1980s are given, based on the Bureau of Labor Statistics' studies of economic growth, technological change and industrial and occupational trends. Available occupational training offered by vocational education, apprenticeship schemes, employer training, armed forces training, Federal manpower programmes, home study courses and colleges and universities are also discussed.

144. U.S. DEPARTMENT OF LABOR, BUREAU OF LABOR STATISTICS. *Rail road technology and manpower in the 1970s.* (Bulletin 1717.) Wahsington, D.C., U.S. Government Printing Office, 1972 (90 p.).

Technological changes in the railroad industry are described and the effects of these changes on employment and manpower needs for the 1970s are discussed. Largely successful worker-adjustment to technological change has been the result of union-management agreed provisions which include advance notice of major change, retraining rights and benefits, moving allowances for relocation, various guarantees of job security and unemployment and retirement benefits.

145. U.S. DEPARTMENT OF LABOR, BUREAU OF LABOR STATISTICS. *Technological change and manpower trands in five industries.* (Bulletin No. 1856.) Washington, D.C., Government Printing Office, 1975 (58 p.).

Some of the major technological changes emerging among selected American industries are appraised and the impact of these changes on productivity and occupations over the next five to ten years are discussed. Reports are included on the paper and pulp industry, the hydraulic cement industry, the steel industry, the aircraft and missiles industry and on wholesale trade. Adjustment of workers to technological change in each industry is also discussed.

146. UNIVERSITY GRANTS COMMITTEE. "Microprocessor education: a report of a national programme for universities". Microprocessor Education Panel Paper 131/78, 14 December 1978, 5 p. mimeo.

The paper discusses "what contributions the university system should be making to educational needs in respect of microelectronics and microprocessors, and outlines the necessary developments to enable it to meet those needs as a matter of urgency".

The panel comprising five (UK) university professors and also industrial representation put forward an estimate of the funding and university resources which will be needed to provide sufficient graduates capable of working on the design and fabrication of microelectronic devices and also capable of incorporating microcircuits and microprocessors into the design of new products.

In this connection they consider the underlying needs in undergraduate education, postgraduate education and research, post-experience courses and consultancy work, and the associated development costs.

147. WEINBERG, E. "Some manpower implications". Chapter 8 in *Automation management: the social perspective*. Athens, Georgia, The Center for the Study of Automation and Society, 1970 (175 p.).

The impact of automation on the economic system is considered. The pace of technological change is increasing but increased technological change is not in and of itself responsible for creating massive unemployment. Any unemployment created by technological change can be offset by increasing levels of demand, and "shock-absorbers" such as advanced notification, training and community co-operation can be used to buffer the impact of technological displacement. More formal education at all levels is necessary to ensure society a sufficient pool of trained technicians to cope with a more technologically advanced future.

148. WHISTON, T.G. "Education and the maximisation problem: a romantic viewpoint?" Paper given to U.K. Futures Network, Grenygog, Wales, February 1978 (28 p.). In P. Holroyd (ed.), *Collected readings on education and unemployment*, London, Pilkington Bros., 1979.

The possible effects of technological change, in particular, microprocessor development, upon the future pattern of industrial employment in the manufacturing sector of the U.K. are examined in the context of wider fears of unemployment due to lack of economic growth. The possibility of a structural unemployment problem heralding a future industrial society which requires a significantly smaller workforce is considered. A socio-economic strategy which emphasizes a highly automated industrial and commercial sector and an expanded education sector is outlined. A number of policy options in relation to "educational-expansion" at all levels of education are examined, together with the various social gains and economic difficulties of supporting such policies.

149. WHISTON, T.G. "Technical change: occupational skill and retraining issues". Presented at the seminar on Employment and Technical Change, Science Policy Research Unit, Sussex University, November 1978, 30 p., mimeo.

The social and educational consequences of microprocessor innovations may shortly need to be considered. While the aggregate effects of the extensive application of microprocessor techniques on skill requirement are not known at present one of the major problems requiring extensive empirical investigations is the degree to which an increasing polarisation of labour into a technocratic group and a comparatively unskilled workforce may occur.

Should the "polarisation" occur, a range of fundamental education-policy questions will be generated.

WOLFBEIN, S.L. See Section 2, No. 74.

IV. Technological change and specific industries and professions

150. ADDISON, C.C. "Education and the public image of chemistry". In *Chemistry in Britain*, Vol. 13, No. 7, July 1977, pp. 258-262.

The public image of chemistry is intimately linked with the nature of the chemical education offered. One of the most difficult problems facing the Chemistry Society is finding the means by which to communicate to the general public some appreciation of the economic and social importance of chemistry. The decline in numbers of pupils interested in chemistry is considered and the pressures which may force chemistry teachers to replace practical work with theory and thereby make chemistry less attractive are discussed.

151. AUEW-TASS. *Qualified engineers - the way forward.* A submission from the Technical Administrative and Supervisory Section of the AUEW to the Committee of Inquiry into the Engineering Profession, AUEW-TASS, May 1978 (43 p.).

Many more highly qualified engineers will be required for Britain to remain an internationally competitive industrial nation. The education, training and qualifications of engineers require reform. Flexible training schemes should be developed to respond quickly to changing needs. Engineering Industry Training Board approved standards should form the basis for qualifications.

152. BELL, R.M. *Changing technology and manpower requirements in the engineering industry.* Watford Engineering Industry Training Board, 1972 (101 p.).

The most important technological changes likely to affect the engineering industry are identified. The likely effects of these changes on the industry's manpower requirements are analysed. The effect of automation on manpower and skill requirements is analysed using a taxonomy of levels of mechanisation and automation. The study argues against the view that large sections of the direct labour force in the industry face the need for substantial retraining as technical changes destroy and create different jobs. However, it does suggest that frequent additional training is necessary as technological change rapidly alters the characteristics of jobs. The problem for training is to meet the diversity and incremental progress of technical change rather than the rapid pace of the introduction of revolutionary changes.

153. BHALLA, A.S. (ed.). *Technology and employment in industry* (with foreword by Amartya Sen). Geneva, I.L.O., 1975 (324 p.).

The text is primarily concerned with presenting a series of case studies of alternative and appropriate technology systems in a range of countries in order to analyse the decision mechanisms which are required in relation to appropriate technology choices. It is argued that "one of the significant conclusions of the analysis is that inappropriate choices are often made not because technical alternatives do not exist, but because selection systems are inadequate, and private and public decision-makers are unaware of the existence of the alternatives".

The comparative studies include the minerals industry in the United States, Zambia, Zaire and Chile; the manufacture of tin cans in Kenya, Tanzania and Thailand; jute-processing in Kenya; sugar-processing in India; engineering in Colombia and metalworking in Mexico, besides economic studies concerned with capital-labour substitution possibilities: a review of empirical evidence; and also an opening chapter by A.S. Bhalla on "The concept and measurement of labour intensity".

154. BLUM, A.A. "White collar workers". In I. Taviss (ed.), *The computer impact* (Program on Technology and Society, Harvard University) Englewood Cliffs, New Jersey, Prentice-Hall, 1970, pp. 69-80.

The effects of automation on white-collar workers and changes in job structure and skill mix are discussed. It is argued that the gap between the less skilled and the higher skilled clerks appears to be growing, although some companies have tried to bridge the gap by training and retraining measures. Because of declining rate in growth of employment in many offices and because of the raising of the skill level in some of the offices, many personnel managers are demanding that new clerks be first employed at a higher level of skill. Therefore, there is a need for the meshing together of the school's education programme with the on-the-job training programmes of industry and the overall adult education programmes prevalent in society, and not to treat them as separate entities as has frequently been the case.

155. BOURNE, J.R. "Education in chemical engineering in Switzerland". Paper presented to the Symposium on Chemical Engineering Education, London, 6-7 June, 1978. European Federation of Chemical Engineers, 5 p.

The national educational system and characteristics of the process industries are outlined. The types of Chemical Engineering courses provided in the two Federal technical universities and at the non-graduate level in several technical colleges are then described. It is suggested that the rate of product innovation is slowing down as research becomes less productive. The emphasis of chemical engineering is changing towards contributions to productivity, safety and environmental protection. The views of several large Swiss chemical firms in 1966 on the topics which should be included in the syllabus of the Zurich technical university are summarized briefly.

156. BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. *Education, engineers and manufacturing industry.* A report to the British Association Co-ordinating Group. London, British Association for the Advancement of Science, 1977 (59 p.).

Ways of influencing a higher proportion of able young people to choose engineering as a career are examined. Mathematics is essential for engineering and problems surrounding the teaching of mathematics are considered. The need to recruit more women into studying engineering and the changes in engineering degree-course requirements at university are discussed. Significant changes in engineering course curricula have been made and schools need to be better informed as to the range of courses available. Companies and universities need to collaborate more to ensure that the options available are suited to their requirements. The roles which could be played by universities, polytechnics, industry, professional institutions and appropriate training boards are discussed.

157. CABINET OFFICE, ADVISORY COUNCIL FOR APPLIED RESEARCH AND DEVELOPMENT. *Industrial Innovation.* London, HMSO, 1978 (43 p.).

The report was concerned primarily to examine the innovative process and how it has operated in Britain compared to other countries. In Britain, Research and Development has become highly professionalised and has come to be seen almost as an end in itself. Encouraged by the emphasis on science rather than engineering in the education system, R and D expenditure has not been deployed well; for example, there has been undue concentration on glamorous new technology, and market considerations have been neglected. With notable exceptions, the academic world has too long ignored manufacturing. Several suggestions are made to remedy this, including the deployment of extra resources to finance major new programmes of work on those aspects of science and engineering which support manufacture. Universities and Business Schools should set up arrangements to help small technology-based firms.

158. CABINET OFFICE, ADVISORY COUNCIL FOR APPLIED RESEARCH AND DEVELOPMENT. *Joining and assembly: the impact of robots and automation*. London, HMSO, 1979 (42 p.).

Quality, reliability and cost of production often depend critically on the correct choice of joining technique and on its skilful application. Selection of appropriate techniques depends on the knowledge of the designer and on his awareness of the detailed characteristics of alternatives. The education of design engineers must incorporate up-to-date knowledge of manufacturing technology. Innovations in joining techniques: welding, brazing and soldering, adhesive bonding, mechanical fasteners and stitching; and in assembly, in particular robotics, are reviewed. The relevance of recycling and reclamation to joining and assembly methods is also considered. In a brief survey of Research and Development, it is noted that the Welding Institute (in the United Kingdom), which provides courses for technicians and for welding inspectors, is precluded by its statute from participating in the qualification process for welders. This is contrasted with the *Institut du Soudre* in France, which devotes 80 per cent of its budget to training, including the qualification of welders. There is some concern that the scale of research in universities and polytechnics is too low to achieve a really effective impact; although welding research is sponsored by industry at Cranfield Institute of Technology, some university and polytechnic work lacks close industrial involvement. The modest level of work on automation in the United Kingdom contrasts starkly with the situation in the Federal Republic of Germany.

159. CABINET OFFICE, ADVISORY COUNCIL FOR APPLIED RESEARCH AND DEVELOPMENT. Computer aided design and manufacture. London, HMSO, 1980 (36 p.).

The Report concentrates on the use of computers in the design and manufacture of discrete products. It suggests that the major benefit to be derived from computer-aided design (CAD) is the improvement in the productivity of designers and draughtsmen which can be achieved. It is commonly accepted that, normally, an improvement in productivity of about 3½ times can be achieved. Similarly, the principal benefit of computer-aided manufacture (CAM) is productivity: but in this case it is mainly the productivity of skilled toolmakers, tool-setters and machine-operators, in short supply in the United Kingdom, which can be improved. Few CAM systems are in operation in the United Kingdom, but a factor of three improvement in productivity has been experienced in the U.S.A. The Report suggests that changes in education and training will be necessary if CAD/CAM systems are to be introduced widely and effectively. The importance of introducing computing principles in schools is stressed, as is the need to retrain existing staff in firms. Potential users of CAD/CAM need to learn to appreciate systems capabilities, and programmers need to be trained. Those now leaving higher and further education are inadequately trained for writing software for computerised engineering. Recommendations are made for courses and for means of increasing awareness of CAD/CAM.

160. CAIN, J.T. "Micro processors and education". In *Computer*, Vol. 10, No. 1, 1977, pp. 9-10.

"This article is the introduction to a special issue of *Computer* which contains selected papers presented at a conference on microprocessors and education, the aims of which were to highlight how microprocessors could be integrated into the curricula and the associated problems, as well as presenting views on what skills will be needed in future in handling microprocessor systems."

161. CARGILL, B.F. & ROSEMILLER, B.E. (eds.). *Fruit and vegetable harvest mechanization: policy implications*. Lansing, Michigan State University, 1969 (838 p.).

The decreasing need for unskilled labour to harvest the annual farm production in the US because of mechanization is considered. Technological change has progressed so quickly in the farm sector that the agricultural worker has been overcome with the rapidity of change. There is an urgent need for new policies, especially in the public sector, to deal with farm workers who are displaced because of technological progress. Recommendations are made regarding retraining, adult education programmes, counselling for displaced workers, creation of public employment, extension of unemployment benefit and encouraging manufacturing firms to locate in rural areas to help employ the displaced workers.

162. CENTRAL POLICY REVIEW STAFF. *Social and employment implications of microelectronics.* London, CPRS, 1978 (24 p.).

This article reviews the possible effects of microprocessors for the United Kingdom economy as a whole, but also specifically examines the future role of computers in the civil service, the use of word processors, and the relevance to the car industry.

There is also, in relation to these sectors, discussion of the possible effects upon skill requirements and changes, the "complementarity" of human and machine skills, and the use of teaching-machines.

163. CRITCHLOW, R.V. "Technical changes in the printing and publishing industry". In *Monthly labor review,* Vol. 93, No. 8, August 1970, pp. 3-9.

The effects of technological change on various occupations and skill groups in the printing and publishing industry from 1947 to 1969 are analysed and tentative projections made for the 1970s. Technology will continue to advance rapidly in the printing and publishing industry. This will probably cause displacement to continue in certain occupations in the industry but it will be mitigated somewhat by increases in the demand for printed products, a slower rate of diffusion of technological change, and extensive retraining. Retraining programmes by both unions and management have already been successfully introduced.

164. CRITCHLOW, R.V., and others. *Computer manpower outlook,* Bulletin No. 1826, Washington D.C., U.S. Bureau of Labor Statistics, 1974 (60 p.).

The objectives of this study were to provide information on the current employment, education and training characteristics on computer occupations, to explore the impact of advancing computer technology on computer manpower and education, and to project computer occupational requirements and their implications for training. Some of the major findings of the study were that employment in computer occupations was expected to grow more slowly over the 1970-80 period than during the previous decade, the distribution of workers among computer jobs was expected to change, and increasing sophistication and complexity of computer personnel functions would require workers with more and better training than in the past.

165. **DEPARTMENT OF LABOUR AND NATIONAL SERVICE, AUSTRALIA.** *Technological change in the printing industry - four case studies.* Melbourne, Department of Labour and National Service, 1969 (43 p.).

The nature of and reasons for introducing change in the firms studied are considered. The effect of change on trade skills, training and manpower requirements and the methods used to handle personnel issues arising from technological change are examined. The studies revealed changes in the nature of some trade skills. Some trades were required to place more emphasis on scientific knowledge and precise measurement, while for others, increased mechanization had emphasized machine-operating skills. A need still existed, however, for traditional skills. Technical changes required the firms to retrain a number of their tradesmen. This retraining enabled some tradesmen to acquire new skills and helped others to fit into other sections.

166. DE SIMONE, D.V. *Education for innovation,* Oxford, Pergamon Press, 1968 (180 p.).

This is a conference report on a meeting organized to examine problems of keeping engineering education abreast of innovations and technological change, with particular reference to the U.S.A. It includes papers and records of discussions on creative thinking and environment, faculty motivation, and the invention process. Teaching methods are also discussed.

167. DUFFY, H. "Enhancing the Education of Engineers". In *The Financial Times,* 12 February 1980.

The Finniston Committee have made several major recommendations concerning the education and training of engineers, partly in relation to the wide variation in course provision standards and styles. This article describes in detail one of the "enhanced" courses which was set up in 1978 (prior to Finniston) by the University Grants Committee. The course described in this article is the Brunel Special Engineering Programme (SEP) which leads to an M.Eng. qualification and attempts to overcome many of the criticisms addressed at a national level to engineering training.

168. EMMERSON, G.S. *Engineering education: a social history.* Newton Abbot, David and Charles, 1973 (384 p.).

The evolution of the engineering profession and the society it has served from mediaeval times to the present is traced. The history of engineering education in a number of countries is surveyed, including Japan, Canada, USSR and the United Kingdom, and ways in which nations have responded to the challenges of new technologies through the education and training of their people are examined. The current state of engineering education in the English-speaking world is discussed and it is concluded that "the engineer is a vital component in the scientific-technological revolution which has precipitated the great crisis of human life on earth which now emerges as the dominant concern of the industrialized nations in the closing decades of the twentieth century", and that engineers and engineering education must respond to this crisis.

169. FINNISTON, M. *Engineering our future.* Report of the Committee of Inquiry into the Engineering Profession (Chairman Sir M. Finniston). London, HMSO, Cmnd 7794, January 1980 (258 p.).

The Finniston Committee examines and makes recommendations concerning future United Kingdom policy in relation to the training and education of engineers. It makes proposals firstly in relation to the training and education of the engineers and secondly in relation to the need for an *Engineering Authority.* "Finniston calls for a three-tier structure, which would consist of education, training and experience - the 'formation' of the engineer. This would lead to three categories of engineer:
(a) the registered engineer diplomate - R.Eng.(Dip) - for those showing potential for leading the development of advanced technology and/or the management of engineering operations;
(b) Registered Engineer (R.Eng.) for the main body of engineers; and
(c) Registered Associate Engineer (R.Eng.(Assoc.)) for those engineers who will work mainly in supporting roles." Whilst a standardisation of courses is *not* called for there is an implicit assessment that a wide variation in the present level of engineering education and training exists.
(The report has been the subject of an extensive number of articles, press and media commentary, critiques etc., both favourable and critical, which are not included in this bibliography.)

170. FISHWICK, W. "The engineering professor's dilemma". In *Impact of science on society,* Vol. 27, No. 4, October-December 1977, pp. 369-378.

There is much debate about engineering education because of public concern for the effect of technology on man's social and physical environment. The pressures affecting engineering educators are discussed and proposals put forward for better teaching. Engineering sciences and methodologies must be taught so that engineers can participate directly in the dialogue concerning technology and society, emphasizing the responsibilities of engineers as managers.

171. FULCO, L.J. "How mechanization of harvesting is affecting jobs". In *Monthly labor review*, Vol. 92, March 1969, pp. 26-32.

The effects of mechanization of harvesting on employment, training, and labour-management relations of farm workers are considered. Current technological developments of harvesting certain crops are described and the consequences of these and similar innovations are discussed. Technological innovation means that, while there will be an overall decline in the number of jobs in this sector, there will also be a need for retraining and for more highly-skilled workers. The prospects for unionization of farm workers are brighter because farm workers will become more highly skilled and their jobs will become increasingly similar to those in industry.

172. GORMAN, L., & MULLAN, C. "Human aspects of the management of technological change: a case study". In *Journal of management studies*, Vol. 10, No. 1, February 1973, pp. 48-61.

This describes the changeover from an outdated cargo warehouse using shelves and forklifts technology to a new semi-automatic facility with electronically controlled freight storage and retrieval and an associated computerized documentation system. The management of the personnel aspects of introducing technological change is illustrated and discussed.

173. GRADON, F. *Maintenance engineering: organization and management*. London, Applied Science Publishers Limited, 1973 (209 p.).

Maintenance engineering will continue to grow in importance as industrial plant and machinery becomes more complex. The growth of industrial organization is outlined and discussed in relation to the development of the service engineering function and its integration into the main organizational structure. The role of present day maintenance engineers is examined. They must not only possess practical abilities and sound technical training but also be competent organizers and administrators. Effective and efficient maintenance can be achieved only by a re-organization of the importance of the two elements in maintenance: administrative and physical.

HARVARD UNIVERSITY PROGRAMME ON TECHNOLOGY AND SOCIETY.
See Section 3, No. 104.

174. HENDERSON, M. "Impacts on social structure consequent upon the introduction of training for computer science into the education system". In *Training policies for computer manpower and users,* (OECD Informatics Studies, No. 9), Paris, OECD, 1975, pp. 136-145.

The article stresses the need for adequate recognition of the need for education of the computer specialist and of the public in order to prepare them for the mass introduction of computer technology. People's perceptions and attitudes to computers are discussed and suggestions as to how this education problem should be tackled are outlined.

175. HIESTAND, D.L. *High level manpower and technological change in the steel industry: implications for corporate manpower planning.* New York, N.Y., Praeger Publishers, 1974 (88 p.).

The purpose of this study was to examine the role that high-level manpower plays in the establishment of new technologies at the plant and industry level. The study revealed that steel executives engage in continuous learning, with the learning pace accelerating as major technological changes and investments are imminent. It was also shown that top-level steel managers are needed to provide leadership, skill, incentives and general climate that evoke and advance technological proposals and that most manpower planning is a response to fairly predictable developments.

176. KAMAL DOW, J. *Historical perspectives of the Florida citrus industry and the impact of mechanical harvesting on the demand for labor.* University of Florida, Department of Agricultural Economics, April 1970 (85 p.).

The study suggests that the impact of mechanization on the demand for skill will be slow to materialize, but by 1980 sizeable shifts in the skill composition of the required labour force will have occurred. Management, labour and government must seize the opportunity resulting from the slowness of the introduction of new technology to institute training and education programmes that will allow the labour force to adapt to new skill requirements. The most difficult group to adapt will be the older and especially non-white workers who do not have sufficient education to allow them to make easy intra- or inter-industry shifts. Suggestions are made for dealing with this problem.

KATRITZKY, A. See Section 1, No. 16.

177. **KAUFMAN, H.G.** *Obsolescence and profession career development.* New York, Amacom, 1974 (193 p.).

The career development for professional workers in the U.S.A. is considered. The effects of employment policy measures and organizational change are discussed. The role of continuing education and possibilities of job enrichment are examined. The causes and cures of "obsolescence" are analysed and a number of related issues are considered, including motivation, the importance of personnel management and the role of management development of professional workers.

178. **KAUFMAN, H.G.** "Work environment, personal characteristics and obsolescence of engineers". Doctoral thesis, New York University, New York, 1970, 120 p. (mimeo).

This considers the problem of obsolescence of technical knowledge and skill of engineers due to rapid technological change. From the evidence of a study of 39 firms in various industries, it is observed that both engineers and their managers perceive obsolescence to be a significant problem which is likely to be serious in the not too distant future.

KORSAKOV, E. See Section 3, No. 110.

179. **LEVINSON, H.M.** "Collective bargaining and technological change in the trucking industry". Part One in *Collective bargaining and technological change in American transportation.* Evanston, Illinois, The Transportation Centre at North Western University, 1971 (723 p.).

Past, present and future trends in the trucking industry, the industrial relations environment and adjustments made to technological change by union and management are analysed. Economic factors which were extremely favourable to the introduction of technological change are considered. The internal structure of the teamsters union is argued as being highly favourable to the acceptance of technological change. Other factors which should continue the favourable environment for the acceptance of change in the inter-city trucking industry are discussed.

180. LEVINSON, H.M. "Collective bargaining and technological change in American transportation: an integrative analysis". Part Five in *Collective bargaining and technological change in American transportation*. Evanston, Illinois, The Transportation Centre at North Western University, 1971 (723 p.).

Discusses past, present and projected trends in the transportation industry in relation to adjustment and public policy towards adjustment. Collective bargaining has been relatively successful in dealing with the problems of labour displacement and manpower adjustment presented by the technological developments of the past three decades. Variations among different union and employer groups in the way acceptable accommodation to change has been achieved are discussed and policy recommendations made.

181. McLEAN, J.M. & RUSH, H.J. *The impact of micro-electronics on the U.K.: a suggested classification and illustrative case studies*. S.P.R.U. Occasional Paper Series No. 7, Science Policy Research Unit, Sussex University, June 1978 (51 p.).

Micro-electronics seems to be distinguished from other technologies because of its pervasiveness in spreading across industrial boundaries. The international competitive position of U.K. industries is likely to be worsened by technical change based on micro-electronics. U.K. industries have management problems in coping with electronics. In particular, British firms have inadequate skills for the designing and marketing of integrated materials' handling of office automation systems. In those activities in which micro-electronic technology diffuses rapidly in the U.K., the direct effect on employment is likely to be more severe and not compensated much by manufacturing employment, since most of the technology will be manufactured abroad.

182. NORMAN, C. "Signs of shifts in employment patterns". In *Nature*, Vol. 255, No. 5506, May 22 1975, pp. 286-289.

The changing trends in manpower needs and employment opportunities for university graduate scientists and engineers in the U.S.A. are examined. After a period of rapid growth, enrolment in higher education in the U.S.A. is levelling off. There is also likely to be an increasingly bleak academic job market for scientists and engineers with Ph.D. degrees. The major implications of this trend for the nature of graduate education are considered. On the other hand, the National Planning Association has forecast that there will be too few engineers and scientists to meet the future of the energy industry. Ways in which the federal government might bring the supply and demand of qualified scientists and technicians more closely into balance are suggested.

183. O'CARROLL, F.T. "Technology and manpower in non-electrical machinery". In *Monthly labor review,* Vol. 94, No. 6, June 1971, pp. 56-63.

The impact of new technology in the non-electrical machine industry and the resultant effects on manpower are considered. The rate of expansion of the industry's output is expected to decline and the pace of technological innovation will decline.

Those finding employment within the industry will require a higher skill level than previously. Management must be more imaginative in its handling of technological change and obsolescence. Effective and timely training programmes will be necessary to ensure that workers can meet the new requirements. Various collective bargaining arrangements have already been incorporated into recent contracts to soften the blow of automation.

184. PRASOW, P. & MASSARIK, F. *A longitudinal study of automated and non-automated job patterns in the Southern California aerospace industry,* Vol. 1. Los Angeles University of California, Institute of Industrial Relations, April 1969 (ongoing volumes).

A sample of employees and management from six companies was interviewed to assess attitudes towards automation and their jobs. Most employees interviewed did not fear automation nor perceive it as a threat to their jobs. Retraining was used extensively in the aerospace industry and, therefore, there was little displacement. The pace of technological change was found to be quite important. A moderate pace was found to be preferable and allowed for smooth adjustment. Skill levels are changing and allow for more flexibility in the hiring process. Highly trained people are needed but relatively unskilled people can be hired at low levels to be trained on the job to work with new equipment. In general, personnel are seeking higher educational levels to achieve higher skill status, better jobs and increased pay.

185. ROBERTS, I.F. & WILLIAMS, R.A. "H.N.C./H.N.D. - education or training?" In *Chemistry in Britain,* Vol. 12, No. 8, August 1976, pp. 255-258.

Discusses findings of a study which attempts to identify the extent to which Higher National Certificate (HNC) and Diploma (HND) courses relate to the industrial organic chemistry background of the students. Current Technicians' Education Council development envisage the eventual replacement of National Certificates and Diplomas by new courses specially devised for the technician of the future. Such new programmes must be "devised with full regard to modern industrial requirements - to take account of any formal training which the student may receive". A number of issues which are pertinent to the required rethinking are discussed and suggestions made for achieving desirable programmes. The need to make HND courses more vocational without detriment to the present academic content is also discussed.

186. ROBINSON, L.A. "Office automation: stimulus and deterrent to clerical growth". In *Personnel journal*, Vol. 50, No. 11, November 1971, pp. 846-855.

The impact of automation on clerical workers and the future labour situation for clerical employees is discussed. The unemployment effect of automation on clerical workers has been exaggerated. Although new techniques have somewhat limited the growth of this employment category, it is experiencing and will continue to experience a healthy growth rate. Some companies have allowed normal clerical labour turnover to absorb the displacement effects of automation and others have retrained or relocated their workers.

187. ROTHWELL, R. and ZEGVELD, W. *Technical change and employment*. London, Frances Pinter (Publishers) Ltd., 1979 (178 p.).

This book emerged from the six-countries programme on Aspects of Government Policies towards Technological Innovation in Industry (The Netherlands, Germany, France, Ireland, Canada and the United Kingdom), and deals with past and future trends of employment (and unemployment) as a function of technical change. Detailed comparative case studies analyse the effect of technical change on employment in major industries and a very useful assessment is made of the impact of microelectronics. The authors suggest that "Human capital and new technology associated with high (level) skills offer the greatest possibilities both for competitive survival and more satisfactory employment opportunities for the growing labour force". In their final summary of the effects of ongoing technical change they suggest that the use of electronic controls has resulted in both *loss* of employment and changes in skill distribution, with accompanying craft de-skilling ... that there generally exists a growing mis-match between skills and job opportunity and that this mis-match may increase in the absence of comprehensive retraining schemes.

188. ROY, G.K. "Chemical engineering education in a developing nation (Indian scenes)". Paper presented at the Symposium on Chemical Engineering Education, London, 6-7 June. European Federation of Chemical Engineers, 21 p.

The history and present state of chemical engineering in India is renewed. Results of a survey of views of practising chemical engineers on the weak points of recent chemical engineering graduates are presented. In the light of this survey, the curriculum committee of the chemical engineering education development centre has formulated a new curriculum which is outlined. Some criticisms of this curriculum are presented. Postgraduate education and continuing education are also discussed. Education should be related to contemporary problems. Chemical engineering education is not related sufficiently closely to such needs as those which arise from the energy crisis, or the need to protect the environment. Insufficient effort is devoted to food engineering and to the search for alternative processes based on microbial participation for the production of materials to fulfil vital social needs.

189. SADLER, P. "Sociological aspects of skill". In *British journal of industrial relations,* 8/1 March 1970, pp. 22-31.

Considers factors which have contributed to compositors in the printing industry retaining their special status despite the fact that mechanization of the industry has greatly reduced the level of skill required. The major factors identified and discussed are the intermediate position of the composing work in relation to white-collar workers on the one hand and blue-collar workers on the other, the bargaining power of the printing unions which stems from the highly perishable nature of the newspaper-periodical product which makes firms particularly vulnerable to strike action, and the nature of workshop organization. It is argued that the importance placed by the printing unions on solidarity and equality tends to de-emphasize the effects of change on the skills required.

190. SCHLUNDER, E.U. & KLEIN, J. "Chemical engineering education in the Federal Republic of Germany". Paper presented at the Symposium on Chemical Engineering Education, London, 6-7 June 1978. European Federation of Chemical Engineers, 9 p.

There are three types of curriculum in chemical engineering courses in universities in the Federal Republic of Germany (the development and structure of these curricula are outlined). In addition an increased number of advanced training courses related to specific topics are offered by the scientific societies, VDI and DECHEMA, at different university locations. The main idea behind these courses is to give professional people the chance to get acquainted with recent developments, accelerating the transfer of scientific developments towards practical application.

191. SECOND REPORT FROM THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY, Session 1977-78: "Innovation, Research and Development in Japanese Science-based Industry", Volume 1: Report, HC 682-1. London, H.M.S.O., August 1978 (40 p.).

A number of witnesses drew attention to the part played by the Japanese education system in Japanese industrial success. The report notes the extent to which the major objectives of the education system at all levels are oriented towards the "information society" and its requirements. There are close links between universities and industry. A much greater proportion of Japanese technologists are engineers than scientists, by contrast to the United Kingdom. There are excellent prospects for graduates in applied sciences and engineering as 50 per cent of directors in Japanese industry are engineering graduates.

192. SECOND REPORT FROM THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY, Session 1977-78: Innovation, Research and Development in Japanese Science-based Industry, Volume 2: Minutes of Evidence and Appendices, HC 682-11. London, H.M.S.O., August 1978 (207 p.).

This report contains the detailed evidence and statistics on which the conclusions of the Report (Vol. 1 above) are based.

193. SENKER, P. *Competition, technical change and skilled manpower in small engineering firms: a study of UK precision press tool manufacturers*. Science Policy Research Unit, University of Sussex, 1979 (88 p.).

This report explores the reasons for small engineering firms' reluctance to adopt new technology. The firms in this industry, unaccustomed to technical change affecting their business, were unwilling to risk committing substantial funds to the purchase of new, expensive, high-technology machines. It appeared that capital would have been available to these firms if they had been prepared to accept the risks involved in the new technology. The report concludes that traditional attitudes apply to education and training, as well as to new technology. Generally, owners and managers of firms in this industry were trained by means of traditional craft apprenticeships and they are suspicious of any attempt to inject formal educational methods into traditional craft training.

194. SENKER, P. "Skill requirements for assembly automation". In *Proceedings of the 1st International Conference on Assembly Automation*. Bedford, England, IFS (Publications) Ltd., 1980, pp. 245-53.

This paper includes a brief consideration of the success of Japanese television manufacturers in introducing automatic assembly methods. This success has been due partly to the larger volume of sets produced by major firms in Japan, and to the greater attention paid to manufacturing engineering in Japan. But heavy spending by Japanese firms on training programmes, particularly for managers, engineers and technicians, has also been a very important factor. Inter-firm mobility is rare in Japan, and the mobile individual is looked on with suspicion, so Japanese firms can be reasonably sure that they will reap the benefit of their heavy expenditures on training. The full economic benefits of automatic assembly will be secured only if substantial resources are devoted to training in all functions and at many levels. But the author warns that the diffusion of automatic assembly is likely to be slowed if Government monetary policies to restrain inflation result in reduction of the funds available for investment; and that the continuance of such policies could result in higher unemployment, thereby stiffening trade-union resistance to automation.

SENKER, P., HUGGETT, C., BELL, M. & SCIBBERAS, E. See Section 3, No. 134.

195. SENKER P., SCIBERRAS, E., SWORDS, N. & HUGGETT, C. *Forklift trucks: a study of a sector of the U.K. engineering industry*. Science Policy Research Unit, Sussex University, September 1977 (195 p.).

Future trends in the forklift truck industry could increase the need for highly qualified staff, including qualified engineers and technologists at the highest levels. For the British industry to be successful, highly qualified staff would need to be used in many functions such as marketing and design. More widespread automation of materials handling will increase the need for electronic engineers and technicians in particular.

196. SMITH, D. *Technological change in Michigan's tool and die industry,* Industrial Development Division, Institute of Science and Technology, University of Michigan, Ann Arbor, Michigan, 1968 (140 p.).

This considers what are the current production techniques used in the tool and die industry, to what extent are industrialists aware of new technologies, what technical and economic factors affect technological change and to what extent will new technologies replace existing skills and manufacturing processes. Data were collected from 122 firms over a 3-year period by personal interview, utilizing an extensive questionnaire. Factors affecting tool-making innovations, and the impact of these innovations on labour, are discussed.

197. SWORDS ISHERWOOD, N. & SENKER, P. "Automation in the engineering industry". In *Labour research review,* Vol. 67, No. 11, November 1978, pp. 230-231.

The proportion of skilled craftsmen in the labour force has not been much affected by the increasing use of numerically controlled machine tools in the British engineering industry. Automation has played some part in causing reduction in total employment in the industry, but the principal cause of loss of jobs has been the lack of investment in research and development and production facilities which has adversely affected the industry's international competitiveness.

198. U.S. DEPARTMENT OF LABOR, BUREAU OF LABOR STATISTICS. *Outlook for technology and manpower in printing and publishing.* Final Report. Washington, D.C., U.S. Government Printing Office, 1973 (45 p.).

Describes changes in technology in the printing and publishing industry. The study focuses on the effect of new technology on productivity, employment and occupational requirements and describes methods of adjustment. Nine printing firms participated in the study and information is included on the impact on production and manpower of electronic computers, phototypesetting equipment, web-offset printing and other innovations.

199. U.S. DEPARTMENT OF LABOR, BUREAU OF LABOR STATISTICS. *Technology and manpower in the textile industry of the 1970s.* Bulletin No. 1578. Washington, D.C., Government Printing Office, 1968 (79 p.).

Changes in the technology of the textile industry are described and their impact on productivity, employment and occupational requirements are considered. The study discusses methods of adjustment to technological change, the implications for education and training, the potential for technological advance and production prospects.

200. VENNING, M. *Professional engineers, scientists and technologists in the engineering industry.* Watford, Engineering Industry Training Board, 1975.

Estimates for the whole population of existing and trainee professional engineers and scientists are established and the education and employment background and the work of the individual engineers and scientists are considered. Manpower planning and forecasting are discussed in relation to future technological changes and the importance of the breadth of training is emphasized. Policy issues are considered, including questions surrounding the mobility of technologists, the attitudes of young technologists and the influence of changing educational opportunities.

201. WHISLER, T.L. *The impact of computers on organizations.* New York, Praeger, 1970 (188 p.).

The impact of computers on the organizational structure, decision-making process, job content and skill requirements in the life-insurance industry is examined. Job content has become more narrow, with a decrease in interpersonal communications and in skills at the middle level, accompanied by an increase in required skills at the top level.

202. ZELIKOFF, S.B. "The obsolescence of engineering personnel under conditions of rapid technological change". (Ph.D. Thesis, University of Pennsylvania, 1968, 222 p.).

This analyses the obsolescence of engineering personnel employed in all economic sectors. The single most important cause of engineering obsolescence, hypothesized to be advances in technical knowledge, is examined in both quantitative and qualitative framework. General patterns of engineering obsolescence are presented and examined in detail in order to uncover the more promising solutions to the problem of the erosion of technical knowledge. The current roles of the individual engineer, the engineering employer, the engineering college, the professional society and various governmental agencies in their attempts to stem the tide of engineering obsolescence are examined and recommendations offered for other programmes which are deemed worthwhile.

V. Planning and development

A.U.E.W. - TASS. See Section 4, No. 151.

203. AVAKOV, R.M. & ZAGEFKA, P. "The place of education in long-term projections for development". In R. Avakov (ed.), *The future of education and the education of the future*. Paris, IIEP, 1980, pp. 175-194.

The current debate on the relationship between development in the future and education is discussed and education's place in the long-term forecast considered. In order to remedy a whole set of critical educational problems "It is not sufficient merely to 'reform', 'restructure' and 'transform' the educational system". Developing countries are suffering from serious deficiences in terms of education. The financial burden of a genuine expansion in the system is proving too great. The developed countries are facing an education crisis resulting, among other things, from mass education and the extension of the system to vast sections of the younger population. The most likely direction of future changes in education is considered and directions for research which may promote changes which are feasible and desirable from both a national and an international viewpoint are examined in detail.

204. BELL, D. *The coming of post-industrial society: a venture in social forecasting*. London, Heinemann, 1974 (507 p.).

The significant changes which are taking place in the economy, class structure and political institutions are identified. The author argues that the singular feature of the post-industrial society is a new principle - "the codification of theoretical knowledge", which shapes innovation in science, technology and social policy. The inadequacies of the usual understanding of social change and social planning are examined and it is proposed that meaningful forecasts about the future of modern society can be made only if the present condition of society is fully understood. Because of changing technology the production of goods will require a decreasing labour force, and growth in production and employment will be mainly concentrated in the "service" areas. Because labour will be gradually replaced by technology, technological expertise will be of major importance and education research and information-handling establishments will be major areas of growth. Government will play an increasing role in the post-industrial state. The author envisages the post-industrial state as increasingly technocratic, with skills and education replacing birth and property as the basis of political power.

205. BESSANT, J.R. and DICKSON, K.E. *Computers and employment: an annotated bibliography*. Published by Technology Policy Unit, the University of Aston in Birmingham, April 1980 (61 p.).

The bibliography (jointly undertaken by TPU and the British Computer Society) provides an extensive review and annotated bibliography of the changing nature of work in relation to automation. Both the manufacturing and service sectors are reviewed. Key issues, including health hazards; impacts on society; Third World; education and training; job creation and destruction; implications for job design and opportunities, are separately considered.

206. BLACKABY, F. (ed.). *De-industrialisation*. London, Heinemann Educational Books, National Institute of Economic and Social Research, 1979 (268 p.).

The contributors to this volume consider whether there is a trend to contraction in British manufacturing industry. If there is, what form does it take and does it matter? If it does matter, what policies are appropriate? Several hypotheses are explored, including issues of competitiveness, labour supply, the rate of technological advance and the export of capital.

The collected papers include discussions of de-industrialisation in the Netherlands and of foreign manufacturing by United Kingdom firms.

207. BLAIR, L.M. *Mechanisms for aiding worker adjustment to technological change. Volume 1: conceptual issues and evidence.* Salt Lake City, Utah University, Human Resources Inst., 1973 (160 p.).

The report reviews current literature dealing with past, present and future political and social mechanisms to assist workers' adjustment to technological change. A basic conern of the study is to what extent government policy is needed. Part One considers the impact of technological change on the labour market and includes a discussion of the effect technological change has on skill sector requirements. Part Two reviews the current literature from 1965 to 1973, summarizes findings on worker displacement, analyses policy recommendations in the literature and indicates needed research. One chapter focuses on which types of workers are affected by technological change with reference to skill, age, sex, ethnic group, occupation and industry.

208. BOWLES, S. "Capitalist development and educational structure". In *World development,* Vol. 6, pp. 783-796, 1978.

The relationship between the accumulation process and educational change in capitalist societies is examined. It is argued that the education system serves the interests of the capitalist class by regulating the labour flow between the capitalist and non capitalist modes of production by raising labour productivity in the capitalist mode, by thwarting the development of either a large and class-conscious workforce or a peasant-worker alliance, and by undermining the ideological and political position of traditional élites. Data are used to support the argument that where the state represents primarily the interests of the capitalist class, it is these objectives which dominate educational policy rather than any commitment to equality of to maximizing the rate of economic growth.

CARNOY, M. See Section 2, No. 44.

THE COMMISSION ON TECHNOLOGY AND THE AMERICAN ECONOMY, See Section 7, No. 256.

209. DEGREENE, K.B. *Technological change and manpower resources: a systems perspective.* Los Angeles, University of South California, 1974.

This synthesizes theories and findings from behavioural and social science and the field of management, as well as from economics and technology. It discusses the socio-technical-system environment in which the interaction between new technology and manpower resources takes place, the measurement of technological change, and how technological change affects manpower. The prediction of skill and manpower requirements and electronics-based computer communications technology are also considered.

210. DRUCKER, P.F. *The age of discontinuity.* New York, Harper and Row, 1969 (369 p.).

The major discontinuities examined are the development of genuinely new technologies and industries based on them, the emergence of a world economy, the new socio-political reality of pluralistic, organized power concentrations and the emergence of knowledge as the "central capital" and most important resource of the economy. In each of these areas recent changes are examined and some policy recommendations are presented.

211. ENCEL, S. "The future of education in relation to the new international economic order". In R. Avakov (ed.), *The future of education and the education of the future.* Paris, IIEP, 1980, pp. 149-174.

In the developed world, rapid inflation and large-scale unemployment together with the prospect of major and highly disruptive technological changes means that the prospect of continued educational expansion is at an end. At the same time the educational policies of the developing countries are being criticized for a variety of reasons. This paper discusses possible educational "futures" in the context of a more general consideration of current thought about the future. The process of forecasting which generally treats education as a dependent variable is considered and the assumptions involved in this view of education are examined. The paper speculates about the effects of those assumptions on the structure of the forecasts themselves and discusses whether or not different assumptions, with different consequences, are possible. The projected and the actual contribution of education to the progress of developing countries is examined and what implications this has for the New Economic Order are considered.

EUROPEAN COMMUNITIES. See Section 3, No. 95.

212. EUROPEAN TRADE UNION INSITUTE. *The impact of microelectronics on employment in Western Europe in the 1980s*. Brussels, ETUI, March 1980 (164 p.).

This report prepared by Mr. John Evans, Research Office of ETUI, considers the impact of microprocessors on employment from both a structural and a qualitative standpoint. In relation to qualitative changes in skills, the report considers the polarisation of employment problem, the disappearance of skills and the increased pressure of work and calls for coordinated government policies - of which education is a part.

(The report is available in English, French, German, Italian, Norwegian and Dutch.)

213. FRAGNIERE, G. (ed.). *Education without frontiers*. Duckworth, London, 1976 (207 p.).

The final report of the education project of "Plan 2000", which presents the main conclusions emerging from the various studies undertaken during the project. Major areas of concern which should be seen as priorities for action in the future are: structure, diversification of resources, regionalization, the status of teachers, the relationship between education and employment, and how best to institutionalize innovation.

HARVARD UNIVERSITY PROGRAM ON TECHNOLOGY AND SOCIETY. See Section 3, No. 104.

HUSEN, T. See Section 1, No. 14.

KASSALOW, E.M. See Section 3, No. 109.

214. KENNET, W. (ed.). *The futures of Europe*. Based on a report to the Commission of the European Communities. Cambridge, Cambridge University Press, 1976 (242 p.).

Considers forecasting in general and the needs of the European Community in particular. Technology assessment and the Europe Plus Thirty group are discussed. Various aspects of the futures of Western Europe are reviewed and a new institution is recommended to develop long-term forecasting on a regular yearly basis. The benefits of forecasting education needs and trends are discussed. Four possible alternative educational futures are presented. The rapid obsolescence of technical knowledge and skills which require frequent retraining is suggested as a major reason for promoting adult education. Present educational developments occurring in many European countries are surveyed and some international comparisons made. Manpower educational needs and problems are discussed. Educational technology is considered in the context of the need for itnernational co-operation. A Community Standards Institute to test course materials is recommended.

215. KUBOTA, G.H. "Technological change and labor skill substitutability: an econometric study". Ph.D. Thesis, Claremont Graduate School, 1975 (305 p.).

This thesis argues that while a variety of measures for aggregating the labour skill mix into a single factor of production have been proposed in various studies, there has been little concern for the influence of technological change on the aggregation of the skill mix itself.

Further, the theoretical limitations of treating labour as a single factor have not been fully developed. With imperfect substitutability between skill categories, aggregate measures of labour should consider the degree to which labour categories substitute for one another. The principal conclusion drawn is that labour skill substitutability is influenced by technical change. However, the degree and direction to which an evolving technology effects skill substitutability are dependent upon how technical change enters the labour aggregating function itself.

LASZLO, E. See Section 1, No. 18.

LINSTONE, H.A. See Section 1, No. 21.

216. MANGUM, G.L. *Adjustment to technological change: summary and policy implications*. Washington D.C., Office of National Research and Development Assessment, 1974 (17 p.).

A supplement to the report on adjustment to technological change, the document reviews policies of recent years related to the adjustment to technological change. It is argued that despite concern at the beginning of the 1960s, little was done through public policy to aid worker adjustment to technological change although considerable progress was made on behalf of displaced and unplaced individuals during the Manpower Decade, 1960-1970. A review of post-1965 literature supports the author's view that technological change is just one of the factors determining future manpower requirements. The opinion expressed is that, given the general mobility and adaptability of the U.S. labour force improvement of forecasting methodology is not a high priority need. Recommendations related to the issue conclude the report.

217. MESTHENE, E.G. *How technology will shape the future.* Cambridge, Mass., Harvard University Program on Technology and Society. Reprint No. 5, 1968. (Also in *Science,* Vol. 161, No. 3837, 12 July 1968, (pp. 135-143).

This argues that the development and adoption of new technologies make for changes in social reorganization and values by creating new possibilities for human action and thus altering the mix of options available to men. The resulting shift in philosophical emphasis will alter conventional thinking regarding personal identity and social stability in the future. Education and the interdependence between industry, government and the university will predominate.

218. MONDELL COGER, R. "A national sense of direction for industrial arts". In *American vocational journal* (Washington), Vol. 43, No. 3, March 1968 (pp. 32-58).

This article criticises variations in educational planning in respect of industrial arts teaching in the U.S.A. It is argued that some measure of unification on a national scale of relevant technical education and vocational training programmes is necessary if the skill requirements resulting from technological change are to be met adequately.

219. NETHERLANDS MICROELECTRONICS STUDY (GT 78035). London, General Technology Systems Ltd., 1979.

The English firm General Technology Systems have undertaken a study of seven culturally and technologically different countries in Europe in order to evaluate the "societal consequences of microelectronics". The countries include Denmark, France, Germany, Italy, Sweden, Switzerland and the United Kingdom (with an annexe devoted to the Netherlands). The study attempts to review all major industrial and commercial developments, government economic and social policy, and in particular educational and training requirements emerging from the ongoing microprocessor development. (The study was undertaken on behalf of the Netherlands Ministry of Education and Science and the Minister for Science Policy).

220. **PSACHAROPOULOS, G.** "Education and work: an evaluation and inventory of current research". Paris, IIEP Working Paper, 1978 (146 p., mimeo).

Several issues touching upon the relationship between education and work and educational planning are reviewed. A summary picture of what is going on in this field is presented and an indication given of what are the most promising research avenues for the future, given past empirical results and the state of current research. "Education" and "work" are defined for the purposes of this survey. Inter-relationsips between education and work are examined in the context of educational planning and the main theoretical streams are analysed. The results of existing research, especially recent research, are classified into those the author is confident about and those that are still subject to dispute. The analysis of on-going current research is based on information supplied by a specially prepared questionnaire which was sent to nearly 1,000 individual researchers and research organizations around the world. The paper includes an extensive bibliography of the area of education and work and an appendix with more detailed information about current research activities.

REZLER, J. See Section 3, No. 130.

SADLER, P. See Section 1, No. 30.

SCHULLER, T. See Section 1, No. 31.

221. **SEFER, B.** "Long-term prospects for the development of education". In R. Avakov (ed.), *The future of education and the education of the future*. Paris, IIEP, 1980, pp. 121-136.

The problems facing education in the future are discussed and the direction in which the future strategy for education ought to be searching for solutions are outlined. The gap between the developed and developing countries in the field of education is discussed and it is argued that this problem is the "central issue of the contemporary world". The role of the scientific-technological revolution in the development of education and the contradictions evident in the fact that the educational boom has strengthened the division between mental and manual work in an era which, by means of the technological revolution, brings them closer together are considered. It is argued, however, that school and education can contribute to the solution of the accumulated social contradictions and various options facing the world.

222. SIEGEL, I.H. & BELITSKY, A.H. "The changing form and status of labor". In *Journal of economic issues,* Vol. 4, No. 1, March 1970, pp. 78-94.

The role and organization of labour and possible changes in work patterns in the future are discussed. Work, as a category of human activity, is not likely to become obsolete in the near future, although concentration of individuals on work will continue to diminish with, among other things, reduced hours, reduced age at retirement and the rise in the average level of education. There should be a substantial increase in employment in the service industries, especially health care and education.

223. SIMMONS, J. *The education dilemma (policy issues for developing countries in the 1980s).* Policy Planning Division, The World Bank, Oxford, Pergamon Books, 1980 (276 p.).

The book questions the adequacy of the Western European and North American modes of formal schooling when applied to Third World countries. "The central dilemma considered is whether a country should continue the rapid expansion of expensive secondary and higher education or should shift major resources to expand the quality and quantity of the relatively cheap primary education and non-formal education for adults. Also a greater match is required between educational product and the employers' needs, together with an equalisation of the distribution of educational opportunities. He includes examples of projects where such an approach has been implemented, but considers the vast majority of countries to have held back because those in control wish to maintain the present power structure."

VENNING, M. See Section 4, No. 200.

WHISTON, T.G. See Section 3, Nos. 148, 149.

224. WHISTON, T.G. "Demographic forecasting and education policy". In T. Whiston (ed.), *The uses and abuses of forecasting.* London, Macmillan, 1979 (Chapter 7, 44 p.).

Recent U.K. education policy is reviewed: in particular, the reduction of the number of teachers to be trained, as a function of demographic development. The appropriateness of the policies in relation to future economic, social, industrial and technological requirement are discussed. The focal point of the article is the extent to which forecasting can be justifiably used as a legitimate policy guide and the dangers which accompany various forecasting procedures.

225. **WHISTON, T.G.** "Education, work and leisure - some broad policy issues". In M. Smith (ed.). *Collected readings of leisure studies association*, Manchester University, 1977 (14 p.).

The education sector's role in relation to leisure and social provision in future decades is discussed. Possible significant discontinuities in total workforce size as a function of technological change are considered. Various social policy options such as increased period of formal education, earlier retirement, intermittent work cycles and their effect upon social life-styles and leisure are briefly examined.

226. **WIRTZ, W.** *Boundless resource: a prospectus for an education-work policy*. Washington, New Republic, 1975 (205 p.).

The expansion of adult educational opportunities in the U.S.A. is proposed as part of a national programme to co-ordinate education and manpower planning. A number of recommendations are made, including suggestions concerning the creation of employment opportunities, social participation in education, the role of the community in human resources development and work-experience programmes. The importance of vocational guidance and methods ensuring its provision are discussed.

ZELIKOFF, S.B. See Section 4, No. 202.

VI. Geographical, regional and development issues

227. ADISESHIAH, M.S. "Future Asian education". In R. Avakov (ed.). *The future of education and the education of the future.* Paris, IIEP, 1980, pp. 269-280.

The paper describes the major educational policy responses in Asia, and in particular India, over the last two decades, where the relationship between policies centring on "manpower planning" and its relationship to the production of a modern economic sector is critically examined. Special emphasis is placed, in relation to future education policy, upon the need for a major shift in the overall direction and thrust in education in India towards "relevances" to future skill needs, the needs of a labour-intensive agricultural technology (and all the associated rural development skills and infrastructures). The author also examines the role of the "informal education" sector and its future development in Asian society, together with the dangers of a national policy which is essentially geared to a formal non-industrial sector which accounts for only 20 million of the overall 220 million labour force. The problem of the "educated unemployed" and the mismatch between the educational output and the employment demands are discussed. Policy suggestions are made for altering this imbalance.

228. AHMAD, M. "Development of nations through science and technology". In *Impact of science on society,* Vol. 26, No. 3, May-September 1976, pp. 203-212.

It is argued that the cause of the underdevelopment of a country lies in the underdevelopment of its people. A programme to develop character, educational facilities, skills and scientific and technical know-how is outlined. Diversification of the educational system and a socio-economic orientation of the universities are partial solutions to the problem. Ways to make science and technology take root in the country and other factors conducive to the solution of economic problems through research are also suggested.

229. BOBROV, L. "Universal higher education". In *Soviet News*, 21 March 1978, pp. 103-104.

The Soviet Union should already be thinking about the introduction of universal higher education because of its prime importance to the economic and social welfare of the people. Universal higher education will be needed in a generation's time because, in the 21st century, the majority of the working population will be linked directly or indirectly with science as a result of the technological revolution. The costs and the arguments for and against establishing universal higher education are considered. The People's Universities have been successful. Universal higher education will have beneficial effects on all aspects of life.

230. CHIJIOKE, M.O. "A practical approach to early technical education". In *Impact of science on society*, Vol. 23, No. 2, April-June 1973, pp. 101-106.

The sociological roots of the "technological gap" between developed and developing countries are considered. A minimum of technological awareness in young people is necessary for the modernization of a nation. An elementary technical training and exposure to mathematics should be essential parts of a child's education. "We cannot become economically rich unless large numbers of population acquire the skill of productive industry. Technology *per se* is arid and unfruitful unless it is matched by the ability of a majority to do things." The increased support of the industrial training of graduate engineers and changes in primary and secondary education may help to solve this problem. Considerable thought, planning and debate is necessary for a complete solution to be found.

231. COLE, S. "A comparison of major long-term projection models and their possible implications for education". In R. Avakov (ed.), *The future of education and the education of the future*. Paris, IIEP, 1980, pp. 195-224.

The long-term economic and demographic projections obtained from a number of global models are described and the value of the results in providing alternative estimates of future requirements for educational resources is discussed. The application of the Bariloche Latin-American model for the purpose of exploring alternative future scenarios is described and modifications which may be required to make the models more relevant to a consideration of education and related policy are indicated. There is a great need to incorporate education into global modelling, particularly in relation to future skill shifts which may or may not come about in the Third World. Specialists connected with the educational establishment, themselves, have an important contribution to make to the field of global modelling.

232. DESSAY, J. "Social factors affecting science and technology in Asia". In *Impact of science on society,* Vol. 19, No. 1, Jan-March 1969, pp. 13-23.

Impediments to the implementation and effective application of modern science and new technologies in Asian countries are examined. The mismatch between the supply and demand of scientists and highly skilled personnel is considered. The inappropriateness and inadequacies of existing training systems explain this maladjustment to a large extent. But social factors contribute to the imbalance. The lack of prestige of scientists, engineers and technicians and the inadequacy of communications between the scientific sector and other sectors of society are considered.

233. DOROZYNSKI, A. "Science, technology and education on the Arabian Peninsula". In *Impact of science on society,* Vol. 26, No. 3, May-September 1976, pp. 193-197.

The modernization of the traditional educational processes is described. This is making a significant contribution to the overall modernization of the Arab peninsula. Rapid scientific and technological progress is necessary for the development of the Arab peninsula and, therefore, large investments are being made in an attempt to achieve "what should amount to a leap from the Middle Ages to the atomic era". An effort is being made both to transfer Western technology and also to revive the original scientific tradition. Proposals are made for changes to primary education, the establishment of technical training facilities and the introduction of compulsory education in some areas.

234. FOMERAND, J., Van der GRAAFF, J.H., and WASSER, H. *Higher education in Western Europe and North America.* New York, Columbia University Council for European Studies, 1979 (229 p.).

A selective bibliography of approximately 800 items providing "a comparative guide to important developments in contemporary higher education". The main emphasis is on recent material including government reports and international agency publications and other items dealing with post-secondary education in Western Industrial Societies.

235. HALLAK, J. & VERSLUIS, J. "Correspondence between education and the world of work: an alternative way of looking at labour force data with examples from Sudan, Singapore, Korea and Thailand". Paris, International Institute for Educational Planning, 1978 (46 p., mimeo).

Data are analysed to show the relationship between job structure and education with a view to leading to a comparative international analysis of job structures. An attempt is made to move away from traditional classifications of occupational/educational structures with a view to producing a more adequate basis for relating education to the world of work. The algorithm developed for aggregating very detailed categories of jobs in such a way as to produce occupational structures in the closest possible correspondence with educational structures is tested on data from four different surveys: the household survey in the Sudan, the manufacturing industry survey in Singapore, the manufacturing industry in the Seoul area and a special survey carried out in Thailand. The problems and difficulties associated with the manpower approach in planning educational developments are discussed. A critical review of the findings of the study and their significance is presented and detailed suggestions made for further research in the area.

236. HANSON, J.W. & CROZIER, D.J.S. American Council on Education. *Overseas liaison committee report on the supply of secondary level teachers in Africa: shifting the locus and focus to Africa*. East Lancing, Institute for International Studies in Education and African Studies Centre, Michigan State University, 1974.

Considers problems of teacher training in English-speaking Africa. The manpower needs and labour supply of secondary-education teachers are discussed. The impact of social and economic developments on educational development are examined. Among aspects covered are the growth of enrolment in primary education, the need for expatriate teachers and problems concerning what the curriculum in secondary schools should comprise.

(Abstracted from G. Psacharopoulos, "Education and work: an evaluation and inventory of current research." Paris, IIEP Working Paper, 1980.)

HUSEN, T. See Section 1, No. 14.

237. KING, K. "The informal sector and its relation to the national vocational training system. A view from East and Central Africa." Paper delivered at the Ministry of Labour, Brazil/ UNDP/ILO/Cinterfor Technical Meeting on Vocational Training Programmes in Africa, Latin America and the Caribbean, Brasilia, 21-24 August 1978 (20 p., mimeo).
(Available from K. King, International Development Research Centre, Ottawa.)

The current role of vocational training in the informal sector of some African economies is analysed and possible ways of producing a closer relationship between the official and unofficial systems are examined, with particular reference to Kenya. Apprenticeship schemes and more diffuse training schemes are discussed. An understanding of some of the mechanisms at work in the informal sector is essential in any attempt to reach out beyond the traditional clientèles of vocational programmes. The government's own planning of the formal-sector training needs (through schools or vocational courses) must take into account the important interconnections between the formal and informal sectors.

238. MAEVSKII, I. "Socio-economic questions relating to automation". In *Problems of economics,* Vol. 12, No. 6, October 1969, pp. 3-26.

Technological progress and its effects in capitalist *vs.* socialist economies are discussed. The extent and effect of technical developments in several capitalist countries are described, unemployment being seen as the primary effect. Technological progress in the USSR is examined and the need for planning in the areas of retraining and relocation of workers displaced by automation is discussed. It is concluded that in the USSR the process of automation does not lead to unemployment as it does in capitalist countries. There is a need, however, for a special nationwide organ that would concern itself with the planned distribution and utilization of manpower resources on an all-union, republic and regional scale.

239. MAYBURY, R.H. *Technical assistance and innovation in science education.* New York, John Wiley & Sons, 1975 (210 p.).

Five projects supported by the Ford Foundation for improving science education in the schools of Argentina, Brazil, Lebanon, the Philippines and Turkey are examined. The events of the programmes are described in the first part of the book. In the second part, the programmes are compared and analysed with a view to interpreting their relevance to innovation in science education and the technical needs that arise from that innovation.

240. MELZER, A. *The social use of India's television satellite. A technology assessment of the INSAT proposal.* Zurich, Centre for Economic Research, Swiss Federal Institute of Technology, 1974 (343 p.).

The possible effects of using a space satellite for the transmission of educational TV programmes to all parts of India are examined. The project under discussion combines two large-scale ventures: a major effort in space technology and the application of advanced communicational means for the promotion of development. The study sets out to define what development in India would mean and in what terms large-scale communicational changes in India should be assessed. The "conditional" results are presented and recommendations made. It is concluded either that INSAT's technical structure should be complemented (e.g. by broadcasting radio), or that it should be completely replaced by a decentralised communication system (such as TV-cassettes, discs, conventional training). Development is much more a problem of creating information than of technically conveying it to the audiences.

NEEDHAM, J. See Section 7, No. 280.

241. ODHIAMBO, T.R. "The planning and teaching of science according to national needs". In *Impact of science on society,* Vol. 23, No. 2, April-June 1973, pp. 95-100.

The historical and contemporary reasons for Africa's tardiness in developing a modern, scientific-technical base for its various national economies are considered. The adoption of an appropriate system now from the technically developed countries is one solution to the problem, while the adaptation of a system to specific national needs is another. A method of scheduling the priorities for research planning, innovation and technical education is proposed and a number of considerations which should help in the setting up of a "science strategy" for Africa are presented. The importance of science-oriented education is discussed.

242. PYLE, L. "Engineering in the universities and development". Paper presented at the Symposium on Chemical Engineering Education, London, 6-7 June 1978. European Federation of Chemical Engineers. (10 p.).

This paper is concerned with relationships between U.K. universities and developing countries. Technology is overwhelmingly important in the relations between rich and poor countries. Developing countries urgently need capabilities in advanced technology. The possible role of U.K. universities can be determined only when the developing countries have established the range of capabilities they need and their relative priorities. Some factors which affect these priorities are discussed.

243. RAHNEMA, M. "Iran: science policy for development". In *Impact of science on society*, Vol. 19, No. 1, Jan-March 1969, pp. 53-61.

There is need to devise and implement an all-encompassing science policy to co-ordinate the complex factors which play a part in a country's economic progress. The Iranian experience is examined. A developing country cannot take full advantage of scientific change and technological innovation without removing out-dated socio-economic structures. The importance of training highly qualified personnel is emphasised and projected extensive educational reforms are described.

244. SANYAL, B.C. & JOZEFOWICZ, A. (eds.), *Graduate employment and planning of higher education in Poland*. Paris, International Institute for Educational Planning, 1978 (308 p.).

The relationship between higher education and employment in Poland is considered. This study forms part of a research project designed to explore in several countries the relationship between the employment of graduates and the development of higher education in quantitative and qualitative terms. An attempt is made to provide a systematic explanation of the various dimensions of the linkage between higher education and the employment of university graduates. Included are discussions on problems of relating education with manpower needs, students' perception of higher education and professional careers, and a methodology is presented for matching graduates' qualifications and expectations with the actual work environment. Some conclusions for strategy based on the findings of each section are also given.

The following studies have also been published within the framework of the research programme on higher education and the employment of graduates:

SANYAL, B.C. & EL SAMMANI, A.Y. *Higher education and employment in the Sudan*. Paris, IIEP, 1975 (246 p.).

SANYAL, B.C., CASE, J.H., DOW, P.S. & JACKMAN, M.E. *Higher education and the labour market in Zambia*. Paris, Unesco: IIEP, 1976 (373 p.).

SANYAL, B.C. & KINUNDA, M.J. *Higher education for self-reliance: the Tanzanian experience*. Paris, IIEP, 1978 (415 p.).

Further studies, and a synthesis report on the project, are in preparation.

245. SAVANÉ, L. "Problems of scientific and technological development in black Africa". In *Impact of science on society*, Vol. 23, No. 2, April-June 1973, pp. 85-94.

Although scientific and technological progress has promoted important improvements in man's living conditions in the world as a whole, nearly all the countries of Africa, Asia and Latin America have been by-passed. The causes of this present situation, which has reduced these countries to "the humble role of technology consumers", and ways in which it can be changed are discussed. The main obstacle to scientific and technological development in Africa south of the Sahara relates to its failure to establish a clear-cut policy. The striking decline in educational standards has largely been the result of the education systems not being fully adapted to the new conditions which arose after independence. Appropriate political, economic and social conditions must be created if a true scientific and technological development is to be possible in Africa. Policy recommendations are made for the promotion of these conditions.

246. SPECIAL COMMITTEE ON REORGANISATION AND DEVELOPMENT OF POLYTECHNIC EDUCATION IN INDIA. *Report of the Special Committee on reorganisation and development of polytechnic education in India 1970-71.* New Delhi, 1971 (212 p.).

This report surveys the present situation of technical education in India. Measures for the improvement of technical education are proposed in the light of the changing educational and manpower needs of technicians. A number of recommendations are made concerning a variety of aspects of the subject including teacher recruitment and teacher training, admission requirements to technological institutes and the form and role of examinations. The importance of vocational guidance and basic training, the benefits of full-time and part-time training programmes and the need for the participation of industry in educational planning are also discussed.

(Abstracted from G. Psacharopoulos, "Education and work: an evaluation and inventory of current research". Paris, IIEP Working Paper, 1980.)

247. TORDA, T.P. "New directions in engineering education: suggestions for developing countries". In *Impact of science on society*, Vol. 27, No. 4, Oct-Dec 1977, pp. 357-367.

Some of the new developments which have taken place in engineering education in the U.S.A. are briefly described and ways in which developing countries might adapt the education of engineers to their specific needs are proposed. The "Education & Experience in Engineering" programme developed and managed by the author is described. Possible uses of educational technologies are discussed and other innovations described. But it is argued that effective education uses methods which suit the goals set by a particular institution and older, already tested, methods exist which could make education more meaningful and more effective.

248. ZUBKOV, V.A. "Science and youth in the USSR". In *Impact of science on society*, Vol. 25, No. 4, October-December 1975, pp. 313-320.

A number of questions concerning the role and status of young scientists in the USSR are considered in the light of the present scientific and technical revolution. The problem of the role of scientists and of the scientific-technical intelligentsia as a whole is particularly significant and the continuing evolution of science and technology places an especially heavy responsibility on the young generation of these specialists. The development and growth of Soviet scientific potential over the last twenty years are described. There is need to move from a phase of essentially extensive science to one of intensive development. The latter would include the growth of efficacy in scientific research, the faster application of its results to economic activity, the training of scientists, marked growth in the physical facilities and technics of scientific institutions and an optimal organisation and management of scientific activity. Recommendations for a future programme of action are given.

VII. Educational technology

249. APTER, M.J. *The new technology of education*. London, MacMillan, 1968 (144 p.).

A description of the major developments in educational technology is given which includes the use of television (both broadcast and closed circuit), programmed instruction, computer-assisted instruction and developments in the teaching of reading, languages and mathematics. The problems involved in using these new techniques in the classroom are considered and the expense, the need to have teachers who can effectively use new teaching methods and the architectural inflexibility of school buildings are examined. The importance of the attitude of the teacher to the new educational technology is also discussed. Suggestions for a "school of the future" which would efficiently use educational technology are made. A bibliography is included.

250. APTER, M.J. & BARRETT, G. "The computer in education and training". In M. J. Apter & G. Westby (eds.), *The computer in psychology*. London, John Wiley & Sons, 1973 (pp. 245-280).

The role of the computer as instructor in schools, universities and training departments is considered. The origin and development of computer-assisted instruction is described and the authors critically examine some of the techniques used in its development. Decision structures, question generation, adaptation of teaching materials and the problem of natural language are discussed in detail. The authors also consider some of the shortcomings and weaknesses of computer-assisted instruction - expense, organizational problems and the inability of the systems to handle natural language flexibly enough. Their main criticism is that: "CAI is too technologically or computer-orientated rather than educational or student-orientated".

251. AVSCOUGH, P.B. "CAL - boon or burden". In *Chemistry in Britain,* Vol. 12, No. 11, Nov. 1976, pp. 348-352.

Evidence from the CALCHEM project (Computer Assisted Learning in Chemistry) and CUSC projects (Computers in the Undergraduate Science Curriculum) supports the claim that computers can be of real use in teaching chemistry. Situations in which the computer can aid the teaching and learning of chemistry are identified and the benefits of computer-assisted learning discussed. The situations are of two kinds: where the role of the human teacher is essentially trivial and/or where the resources available to the teacher are inadequate and the computer can remedy this. The possible roles of the computer, the costs and problems are discussed and staff and student attitudes are examined.

252. BLOW, D. "Microprocessors in schools". *Mathematics in schools,* January 1980, Vol. 9, No. 1, pp. 15-16.

Reviews use of microprocessors in school teaching - both the advantages and disadvantages. Amongst disadvantages includes "micros are slower and have less memory than mainframe computers". But the main disadvantage is the substantial capital outlay if all peripherals are included.

253. BURGRAEUE, P.R., KONGUETSOF, L. & MIUS D'ENTREMONT, M. *Films for the teaching of mathematics in Europe.* Strasbourg, Council for Cultural Co-operation, 1970 (118 p.).

The films available in the past decade in Europe on the teaching of mathematics are listed, together with their technical details. An attempt is made to discover whether existing material is adequate and effective in the context of modern teaching of mathematics. A number of recommendations on desirable directions of future developments in production and use of films dealing with mathematics are made.

(Abstracted from IIEP Bibliography, Paris, 1978.)

254. CAMPEAU, P.L. *Selective review of the results of research on the use of audio-visual media to teach adults.* Strasbourg, Council for Cultural Co-operation, 1972 (33 p.).

Results of experimental studies on the instructional effectiveness of audio-visual media in adult education are summarised. Approximately 1,200 research and research-related publications were used in this examination of data. Of these, little more than a dozen studies were considered to have met screening criteria. Particularly common methodological defects in recent media research are enumerated and new strategies for future studies are suggested.

(Abstracted from IIEP Bibliography, Paris, 1978).

255. CLARK TROW, W. "Educational technology and the computer". In *Educational technology*, Englewood Cliffs, New Jersey, Vol. 17, No. 12, December 1977, pp. 18-21.

Considers some of the weaknesses of present educational procedures and discusses the possible benefits of computer-assisted instruction. Some of the major criticisms of computer-system control of education are examined and there are suggestions for facilitating educational reform.

256. COMMISSION ON TECHNOLOGY AND THE AMERICAN ECONOMY, THE. *Technology and the American economy: the report of the Commission*. Appendix Vol. IV, *Educational implications of technological change*, 1966 (150 p.).

The application of computer technology and its relevance to instruction and learning is discussed and various recommendations are made. A short survey of the historical background to educational technology is presented together with a discussion of the situation at the time and possible future developments. Educational innovations likely to occur over the ensuing ten years are evaluated and possible changes in the use of television, videotape, etc. in education are considered. Various aspects of education in the U.S. are presented. Expectations and goals for adult education, the concept of the learning society, education as preparation for and in relation to employment and compensatory education for culturally disadvantaged children are discussed. Educational policy in general and the role of the Federal government in particular are also discussed.

257. COUNCIL FOR CULTURAL CO-OPERATION. *Direct teaching by television*. Strasbourg, Council for Cultural Co-operation, 1969 (47 p.).

This is a digest of reports of a seminar held in the Netherlands which was mainly concerned with adult education. Both the determination of needs and the evaluation of results are discussed. By comparing the different methods used in Europe, the report aims to pool the experience gained and co-ordinate the action of educationalists and radio and television specialists.

(Abstracted from IIEP Bibliography, Paris, 1978).

258. COUNCIL FOR EDUCATIONAL TECHNOLOGY. *Educational technology: a contribution to the improvement of education. A comment by the Council.* London, Council for Educational Technology, March 1978 (11 p.).

This suggests various ways in which educational technology can contribute to improving education. Careful planning of the relationship between educational demands and the resources of the education service and efficient use of the professional expertise of teachers is necessary. The importance of integrated planning of content and method is discussed. Sharing of specialist resources made possible by the use of computer facilities between educational establishments and "distance learning" techniques are advocated. An efficient and active information system which would inform teachers of available teaching materials has important benefits. The production of such materials should be a priority. The education system must concern itself not only with the maintaining and transmitting of cultural values but also with fitting young people for employment in a fast changing increasingly technologically-orientated world.

259. DAVIS, T.C. *Open learning systems for mature students.* London, Council for Educational Technology, 1978 (145 p.).

Considers how present open-learning systems can be extended so that mature students seeking a formal qualification can readily study the subjects of their choice at times and places which suit their particular needs. What provision is actually being made for such students in Britain is investigated and what potential for developments of such provision there exists is examined. Those schemes in the planning stage at the time of investigation are included in the discussion. The case studies included illustrate ways in which problems were overcome in practice and features of the existing situation in education which would inhibit the wider development of open-learning provision are identified. Ways in which such constraints might be relieved are suggested.

260. DICKSON, E.M. & BOWERS, R. *The video telephone. A new era in telecommunications. A preliminary technology assessment.* Chapter 14: Impacts in education. Prepared for the National Science Foundation, Research Applied to National Needs, U.S.A., 1973 (pp. 177-184).

Considers how the video-telephone might be used within and outside the traditional education institutions and discusses the benefits of its use in libraries. It is argued that although video-telephones would be well suited also to serve as terminals for computer-assisted instruction in the home, business and educational institutions, other technologists may pre-empt the role they could play. Because of its face-to-face capabilities, the video-telephone will join other technologies in lessening the importance of the physical location of an educational institution and many competing versions of Britain's Open University may develop. This will be accompanied by significant changes in the social structure of the educational establishment. Through its effects on education it may come to be considered as a tool to achieve broad social change.

261. DIEUZEIDE, H. *Educational technology and development of education*. Paris, Unesco, 1970 (24 p.).

This paper provides basic information on the uses made of technological change and innovation in education. It covers audio-visual aids, programmed instruction, mass communication, media and computer-based teaching. Cost considerations are discussed and the role of the teacher is examined.

262. *EDUCATIONAL COMPUTING*. "Micro takes computing for non-expert to Brunel campus". In *Educational computing,* April 1980, pp. 28-9.

The article describes the setting-up of a microcomputer laboratory at the Uxbridge (Brunel University) site. Work includes "Pet" versions of the Chelsea College science simulation projects. The project also emphasises the psychological interaction between students and computers in the learning process. "It is probably one of the most powerful psychological interactive systems of its kind in the world."

263. FIELDEN, J. & PEARSON, P.K. *The cost of learning with computers: The report of the financial evaluation of the National Development Programme in computer assisted learning.* London, Council for Educational Technology, 1978 (216 p.).

Reports the findings of a four-and-a-half-year project which was concerned with studying the financial and resource implications of a number of development projects in a range of educational and training establishments. The problems arising from an attempt to measure the costs and resource implications of educational change are discussed.

264. GRIFFIN-BEALE, C. "Teacher substitute, peripheral force". In *The Times educational supplement*, 15.9.78, pp. 27-28.

The evolution of schools television is discussed. Far from supplanting the teachers, schools television programmes rely, for their value, on skilful use by teachers. Primary schools prove much keener consumers of schools television than secondary schools. The problems of schools television are discussed and it is predicted that videocassettes will revolutionize the distribution and use of schools television material. At present, few schools have enough machines or tapes for all the teachers' needs. Schools television could help careers programmes but so far have not proved popular. The full impact of the new technology will not be felt until programmes can be fed to small monitors for individual or group use.

265. GROPPER, G.L. "You can lead the public to educational technology but you can't ...". In *Educational Technology*, Englewood Cliffs, New Jersey, Vol. 16, No. 40, 5 July 1976, pp. 40-45.

Considers why educational technology is making so little headway in the education market place when problems still exist which it could help to solve. The reasons for this are given as the widespread and palpable indifference and even hostility to educational technology; the fact that its effectiveness and efficiency is debatable and the high cost of its production. Each of these problems is discussed and solutions put forward. It is argued that educational technology has not been developed correctly, that there is not enough empirical try-out and revision and that some old-fashioned public relations should be built into the diffusion process.

266. GUILLIN, M. *Closed circuit television in universities - problems connected with the economic viability of CCTV in universities*. Strasbourg, Council for Cultural Co-operation, 1974 (27 p.).

An evaluation of the cost/benefit aspects of CCTV systems is necessary because of the increasingly sophisticated technical equipment employed. The problem of cost/output and cost/efficiency factors are discussed. Technical and economic points of view which must serve to exploit the medium to the full are considered.

(Abstracted from IIEP Bibliography, Paris, 1978).

267. HALL, P. "Information, education and power". In P. Hall (ed.), Europe 2000. London, Duckworth, 1977, pp. 156-174.

Various aspects of the new communications technology and the probable continuing role of the current media are considered. The problems this new technology may raise for the individual and for society and its effect in the field of education are discussed. It is argued that education is going through a crisis at present and a number of current trends which will be of major importance in determining the appearance of the education systems of Europe in the year 2000 are identified. These are the drive to equality of opportunity, the drive towards lifelong learning, the drive to participation and autonomous learning and the drive towards transforming the teacher into a counsellor. These drives are discussed in relation to the role which will be played by communications technology in the future.

268. HICKS, B.L. and HUNKA, S. *The teacher and the computer.* Philadelphia, W.B. Saunders Co., 1972 (219 p.).

The treatment emphasises the role of the teacher, educational objectives, strategies and the content and logic of CAI lessons. The authors attempt to overcome the "obsolescence" problem in teaching structures by providing open-ended and dynamic methods of instruction.

269. HOOPER, R. *The National Development Programme in computer assisted learning. Final report to the Director.* London, Council for Educational Technology, 1975 (200 p.).

This sets out and discusses what the National Development Programme in computer-assisted learning has achieved in relation to its main aims - the "institutionalisation of computer-assisted and computer-managed learning in a wide range of institutions". Reports from the independent evaluators on the education potential and the costs of CAL and CML are included. The programme's implementation is described. All levels of educational, civilian and military sectors are covered. The final conclusions of a future study carried out by the Programme on computers in education and training in the 1980s are included. Recommendations for central government policy in the years immediately following the Programme's closure and in the 1980s are outlined.

270. HUBBARD, G. "Micro-electronics: their implications for education and training". London Council for Educational Technology, 1978. (Internal document, 9 p., mimeo).

The micro-electronics revolution will result in a decline in the demand for labour and hence produce an increase in leisure time. Ways in which education and training might contribute to meeting the possible consequent social problems are suggested. The contribution micro-electronics might make in such a situation through the use of educational technological devices which would increase the opportunities and availability of education and training is also discussed.

HUSEN, T. See Section 1, No. 14.

271. KOMOSKI, P.K. "The continuing confusion about technology and education". In *Educational technology*, Englewood Cliffs, Vol. 9, No. 11, November 1969, pp. 70-74.

The interaction between technological change and education with particular reference to innovations in the use of teaching aids are discussed. The uses of audio visual aids including television, computers and films and the importance of the learning environment are discussed.

272. KOTLER, P. "Educational packagers: a modest proposal". In *The Futurist*, Vol. 12, No. 4, August 1978, pp. 239-242.

Educational technology may be the answer to providing better instruction to more students at a lower cost. The development and use of holography will make it possible for a single professor to teach hundreds of students by having his 3-dimensional image projected simultaneously into dozens of classrooms. Educational packages prepared by specialists, consisting of tapes, films and textbooks, are another possible answer to the rising costs and declining standards of teaching. Such packages can be developed for a variety of presentations. Competition among educational packagers would ensure quality and variety.

273. LEFRANC, R. *Higher education distant study systems*. Strasbourg, Council for Cultural Co-operation, 1973 (151 p.), with detailed bibliography).

Various experiments which provide post-secondary distant study by means of radio, television, correspondence and other media are described. Their aims, methods, organization and results are analysed and a comparison made with similar experiments outside

Europe. The aims of distant study systems are examined and it is concluded that generally, they provide one of the most satisfactory solutions available in an "active all-level education system".

(Abstracted from IIEP Bibliography, Paris, 1978).

274. LEWIS, P. "New dimensions in educational technology for multi-media centres". In *Library trends* (Urbana), Vol. 19, No. 4, April 1971, pp. 399-523.

This is a compilation of articles on new trends and innovations in teaching aids for multi-media library centres in higher-education institutions in the U.S.A. Learning theories and audio-visual aids including radio, television films and microfilms are considered. Study cartels linked to computerized information-retrieval systems, programmed instruction, equipment needs and the role of the librarian are also discussed.

275. LICKLIDER, J.C.R. "Libraries and information". In I. Taviss (ed.), *The computer impact,* Englewood Cliffs, New Jersey, Prentice-Hall, 1970, pp. 260-271.

Futuristic look at computerised information systems that might replace conventional libraries and discusses problems associated with the high cost of such operations and the large computer memories required. The difficulties of developing unambiguous English that both the machine and the reader will find easy to use are considered in detail.

276. MACDONALD, B. & WALKER, R. "Project technology - a case study in curriculum insemination". In B. Macdonald and R. Walker, *Changing the curriculum*. London, Open Books, 1976, pp. 102-115.

The chapter reviews the failures and successes of "Project Technology" - one of the major projects sponsored by the United Kingdom Schools Council, undertaken to investigate the curriculum changes, resource provision and teaching methods necessary to improve the transmission of technological knowledge and applied science at secondary-school level.

The authors discuss in detail the institutional difficulties in changing curricula and also in evaluating the success or otherwise of curriculum innovation. The project specifically emphasized that an important characteristic was to "bring about a change of attitude to technology". The relationship of the project as a catalytic force in leading to the formulation of the National Centre for School Technology and the Open University courses on technology are examined

277. MALLINSON, P. & PETERS, D. "Gaussian 70: computer teaches theoretical chemistry". In *Chemistry in Britain*, Vol. 14, No. 4, April 1978, pp. 191-193.

Considers the use of computers for teaching chemistry students. Describes a computer programme package which simulates conventional experiments to give students wave function data. The benefits and drawbacks of this package are discussed; the kind of information which the package returns to the user and three examples of its use are given. The package allows every student who has access to a central computer to do good-quality computation of molecular wave functions in a few hours' work.

278. THE NATIONAL COMMITTEE FOR AUDIO-VISUAL AIDS IN EDUCATION, THE EDUCATIONAL FOUNDATION FOR VISUAL AIDS IN EDUCATION, & THE EDUCATIONAL FOUNDATION FOR VISUAL AIDS. *Internavex 78:* Conference of the International Council for Educational Media: Alternative Learning Systems, 17-19 October 1978.

The conference (see November 1978 issue of *Visual Education* for individual conference papers) was devoted to the development, description, ongoing research and system requirements of "Alternative Learning Systems" with special reference to so-called "Distance learning schemes" (non face-to-face teaching situations, viz. ones where various forms of technology or media - books, television, radio, telephone, computer terminal, computer-assisted learning - played a considerable part).

The various papers attempted to review the system and human requirements and in particular to relate such requirements to anticipated social and industrial shifts. Thus, for instance, in relation to future U.K. higher-education policy it was envisaged that if an expanded demographic and social base were to be engaged in the higher-education process, if due to technological development increasing reliance on retraining and continuous education schemes were to occur, then for a variety of social, institutional and economic reasons various forms of "distance-learning schemes" would be required, using a wide permutation of audio-visual and communication systems.

The papers fell into six categories:

(a) *The problems facing education today* (Georg Kahn-Ackermann, Secretary General, Council of Europe)
(b) *What are the alternative learning systems?* (John Coffey, Council for Educational Technology for the U.K.)
(c) *Case studies* from France, England, Scotland and Germany
(d) *Principles, techniques and design criteria of alternative learning systems* (Professor David Hawkridge, Institute of

Educational Technology, Open University)
(e) *The changing role of the teacher* (Dr. Gaye Manwaring, Dundee College of Education)
(f) *Implications for education and pointers for the future* (Professor Lewis Elton, Institute for Educational Technology, University of Surrey).

279. NATIONAL COUNCIL FOR EDUCATIONAL TECHNOLOGY. *Computers for education*. Report of a working party under the chairmanship of Professor J. Black: Working paper No. 1, London, National Council for Educational Technology, 1969 (43 p.).

The role of the computer in British education and training is evaluated. The advantages claimed for the new techniques, the possible drawbacks and the economic implications are discussed. The potential uses of computers in education are considered and include helping to plan and administer educational systems, as an educational resource to instruct and test students and to assist in educational research. Possible subject areas for the application of computer-based learning systems are suggested. Examples in the school sector, the further and higher-education sectors, the vocational and industrial-training sector and the defence sector are discussed.

280. NEEDHAM, J. "Springtime for the people, springtime for science". In *Nature*, Vol. 274, 31st August 1978, pp. 834-837.

The science-policy conference held in Peking in March 1978 is reported. There is need to raise the scientific and cultural level of the Chinese nations so that modern production techniques can be mastered. Higher scientific and technical education and the dissemination of popular science should be encouraged. The "Outline National Plan" for the Development of Science and Technology" was presented. This sets out a number of policies aimed at achieving the building of an enormous force of scientific and technical personnel. Radio, television and films should devote more time to the dissemination of science and technology.

281. O'BRIEN, T. "Media obstacles". In *The Times educational supplement*, 15.9.78, pp. 28 & 30.

Why schools' televisions remain unused or under-used in many schools is discussed. The hostility and superstition of head teachers, problems of school timetabling, lack of information for teachers about the programmes and inadequate training for teachers in the best use of television are cited as reasons for the failure of schools' television. The official view of the

British Broadcasting Corporation is that the reason for the incorrect use of schools' televisions is that teachers' expectations of educational television programmes are often too high and unrealistic. Too many teachers fail to see television as one of a number of teaching resources.

282. OETTINGER, A.G. "The schools". In I. Taviss (ed.), The computer impact. Englewood Cliffs, New Jersey, Prentice-Hall, 1970, pp. 210-216.

Considers educational technology and individualized instruction and their possible role in reforming the American education system. The author is critical of the present use of educational technology to solve educational problems. He argues that "education's institutional rigidity combined with infant technology's erratic behaviour preclude really significant progress within the next decade, if significant progress is interpreted as widespread and meaningful adoption, integration and use of technological devices ...within the schools". The need for an empirically validated theory of teaching is stressed.

283. OETTINGER, A.G. & MARKS, S. *Run, computer, run: the mythology of educational innovation*. Harvard, Mass., Harvard University Press, 1969 (302 p.).

The prevailing myths about educational technology are considered and its problems defined. The author sees a need for distinguishing between the long-range promises of educational technology and the technology ready for immediate delivery. It is argued that instructional technology can lead to genuine improvements in education provided it is not force-fed or prematurely applied. Education is in need of salvation but the possibility of real aid from a quick "technological fix" is slight. The author analyses the devices of educational technology and also the institutional settings into which it is being introduced. He considers that the hardware is still primitive, knowledge about how to apply it is even more primitive, but the biggest obstacle to the rapid and effective introduction of technology into schools is the structure of the American school system itself. Some suggestions about the form necessary institutional changes might take are made.

284. SCHMIDBAUER, M. *Closed circuit television in universities - reactions and attitudes of professors and students.* Strasbourg, Council for Cultural Co-operation, 1973, (31 p. with detailed bibliography).

The opinions of university teachers and students regarding the educational output of CCTV are examined. The users' opinions are an important factor to be considered when evaluating the success of CCTV. A distinction is made between users and consumers of the educational television medium. The resistance to the spread of college-level TV instruction stems mainly from the user group: the professors. This attitude is more individual than collective.

(Abstracted from IIEP Bibliography, Paris, 1978).

285. SEIDEL, R.J. & RUBIN, M.L. *Computers and communications: implications for education.* Proceedings of the conference on "Computer Technology in Education for 1985" at Airlie House, Warenton, Virginia, 15-18 September, 1975. New York, Academic Press, 1977 (409 p.).

Key developments in computer and communications technology that are expected to have a major impact in 1985 are identified and discussed. A number of legal, political, economic and social issues which may be raised or affected by the use of educational technology are considered. The rapid development of computing and communications systems provides an opportunity for educators to improve the learning and teaching process and the way schools are organized and managed. More generally, the changes in the capabilities and economics of computing hardware are having and will have increasing impact on all aspects of business, govenment, industry, media, communications and transportation. Education must respond to these changes. For the educational process to be economically viable in such a society, students must have access to electronics media.

286. SUPPES, P. "The school". In I. Taviss (ed.), *The computer impact.* Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1970, pp. 203-209

Discusses computer-assisted learning and individualized instruction. It is argued that the necessary technology is already available although preparing curriculum for individualized instruction is expensive and as yet there has been little operational experience in how to do it. The author predicts that within the next decade individualized instruction will be common in elementary schools and in the near future it will be available on a broad basis. The implications of the general use of individualized instruction are considered and possible criticisms of educational technology are discussed.

287. TAYLOR, L.C. *Resources for learning*. Harmondsworth, Mddx., Penguin Books, 1972 (302 p.).

The book deals with methods of learning in secondary schools. The present shortcomings of the British secondary-education system are set out and alternative systems which illustrate a variety of ways of dealing with these problems are discussed. Various forms of education innovations encountered by the author in America, Sweden and the USSR are examined, which include self-tuition, team teaching and learning laboratories. Past attempts at dealing with education problems are reviewed and ways in which correspondence colleges, educational broadcasting and the computer could be usefully employed are considered. The possible benefits of C.M.I. and C.A.I. are discussed and the Swedish 'Individualized Maths. Instruction Course' is examined in detail. Some of the problems and possibilities of package-based learning are considered and it is suggested that independent resource-based learning should be thoroughly tested as an alternative to class teaching in secondary schools. The case for independent learning is summarized and an indication given of to what extent it may help with the problems outlined. Drawing on the work of a variety of educationalists and upon the recent experiments and inquiries of the Nuffield Foundation's 'Resources in Learning Project' suggests ways in which a renewed effort to establish independent learning might now be mounted.

288. ULLERY, J.W. "Individualized instructional systems for vocational education". In *Educational technology,* Englewood Cliffs, Vol. 11, No. 3, March 1971, pp. 22-25.

"Project Able", a systems approach to technical education in the U.S.A. using "individualized instruction", is discussed. The role of the teacher and the student in the learning process is outlined and the importance of student performance records and evaluations are stressed.

289. U.S. CONGRESS, HOUSE COMMITTEE ON EDUCATION AND LABOUR, COMMISSION ON INSTRUCTIONAL TECHNOLOGY. *To improve learning - a report to the President and the Congress of the United States*. Washington, 1970 (124 p.).

This report considers the exploitation of mass-communication media and innovations for use in the educational process. It includes proposals on research to improve teaching methods.

The potential use of audiovisual aids, programmed instruction and simulation techniques are discussed and the report also includes the financial and administrative aspects of using instruction technology.

290. VAIZEY, J. HEWTON, E. & NORRIS, K. "The costs of new educational technologies". In *Arquivo do Instituto Gulbenkian de Ciencia, Estudos de Economía e Financas* (Lisboa). Vol. 6, No. 1, 1971, pp. 1-62 and Vol. 6, No. 2, 1971, pp. 67-102.

The cost of innovations in secondary education and of the use of technological teaching aids are estimated. The financing of an educational television system and the use of other audiovisual aids in the teaching of mathematics and biology are examined. The introduction of the "learning package", based on programmed instruction, will increase costs since there is no indication that manpower needs for teachers will be reduced.

291. VENNING, P. "Snoring robot in commercial assault on home-learning market". In *The Times educational supplement*, 20.10.78.

The development of the micro-processor ship makes possible home-learning devices. A number of home-study gadgets are described. A complete home computer is possible and the educational aspects of such computers will be a key selling feature. The problems associated with computer-assisted learning in the classroom are examined. Even if programmed learning is not strictly suitable for conventional academic education, it has a clear and obvious role in industrial and vocational training and in educating the handicapped and those with special learning difficulties.

292. VIET, J. *EUDISED 1971: Report on the Steering Group.* Strasbourg, Council for Cultural Co-operation, 1971 (40 p.).

The implications of the introduction of a European Documentation and Information System for Education (EUDISED) are discussed and the activities of the EUDISED Steering Group described. The general situation of educational information is considered and national educational documentation projects, the international context and the structure, operation and common standards of the proposed system discussed.

(Abstracted from IIEP Bibliography, Paris, 1978).

293. **WILLIS, N.** "Plans, potential and view data service". In *The Times educational supplement,* 15.9.78, p. 31.

The Post Office view data service, Prestel, and the teletext system are discussed and their possible relation to the educational service is considered. The systems are described and it is concluded that the G.P.O.'s Prestel would seem to be more potentially useful than the Teletext system, for it will be offering information from hundreds of "information providers". The cost of the system may be a problem - not only the amount but also the question of who pays for what. Prestel is potentially very useful to the education service but many questions need consideration. The Council for Educational Technology is currently concerned with looking at these problems.

294. **ZIEL, H.R.** *Man, science, technology: an educational program.* Edmonton, I.D.B. Press, 1971 (216 p.).

This outlines an experimental programme of educational innovation which covers science, technology and the industrial arts at secondary-education level in Canada. The programme discussed is based on computer-assisted teaching methods and a network analysis approach to curriculum development.

Educational technology for the handicapped

295. **AMERICAN FOUNDATION FOR THE BLIND.** *Research Bulletin.* New York, International Research Information Service (published irregularly twice a year).

Contains abstracts and surveys of current research on problems/difficulties of the blind. Papers are occasionally included on the use of educational technology to help solve some of these problems.

296. **BLASCH, B.B., WELSH, R.L. & DAVIDSON, T.** "Auditory maps: an orientation for visually handicapped persons". In *The new outlook for the blind,* Vol. 67, No. 4, April 1973, pp. 145-158.

Auditory maps are discussed and their possible benefits evaluated. What kind of information should be included on such tapes is considered and suggestions made for the use of specific mobility techniques and recordings of particular sound cues that might be encountered. Sample scripts for auditory district and route maps are included. The relative merits of auditory maps and other kind of maps are evaluated and it is suggested that there are a wide variety of potential uses of such recorded travel aids.

297. DAVIDSON, T. "Braille tests with 'tactual response button' allow for unaided test taking". In *The new outlook for the blind,* Vol. 67, No. 4, April 1973, pp. 158-160.

The development of a system which enables a blind subject to take tests without the use of a reader or recorder is described. A "response button" is formed in the thermoformed plastic sheet on which the questions and choice of answers are reproduced in braille. The buttons are simple to use, and because of the nature of the plastic, the tests are easily re-usable.

298. DAVIS, P., ASARKOV, J. & TALLMAN, C.B. "A closed circuit television system as a reading aid for visually handicapped persons". In *The new outlook for the blind,* Vol. 67, No. 3, March 1973, pp. 97-101.

The benefits of closed-circuit television reading systems for visually handicapped persons are discussed. The system is described and its shortcomings considered. It is suggested that more research is necessary but the evidence from a small study already carried out indicates that the system is potentially very useful.

299. DICKSON, E.M. & BOWERS, R. "Video telephones and the deaf". Chapter 12 of *The video telephone. A new era in telecommunications. A preliminary technology assessment.* Prepared for the National Science Foundation, Research Applied to National Needs, U.S.A., 1973, pp. 148-154.

Considers the benefits of video-telephone for the deaf and discusses the role and possible consequences of its wide-scale use for this section of the population. Potential difficulties and problems are discussed. Alternative telecommunication devices for the deaf are examined but the video telephone is considered to offer the best potential for increasing communications options for the deaf. Policy issues are raised and suggestions made.

300. GOLDISH, L.H. & MARX, M.H. "The visually impaired as a market for sensory aids and services: aids and services for partially sighted persons". In *The new outlook for the blind,* Vol. 67, No. 7, September 1973, pp. 289-296.

The nature of partial sight is discussed and the number of partially-sighted persons in the U.S.A. is put at approximately six million. The specific nature of the needs of such persons for aids and services is examined and the provision of low-vision care in the U.S. is evaluated. Specific aids are considered in detail. The benefits and drawbacks of closed-circuit television magnifiers, the high cost of the systems and the difficulties of marketing them are discussed. It is concluded that present technology and medical knowledge are adequate for the needs of low-vision persons, but there is a lack of public awareness and an inadequate delivery system.

301. FRIEDMAN, G.R. "The C-C TV reading system: fact or fiasco". In *The new outlook for the blind,* Vol. 67, No. 8, October 1973, pp. 346-351.

The basic principle of closed-circuit television and its uses in low-level vision rehabilitation are described. A general critique of the system as it is currently being marketed is given. The unsolved problems discussed include poorly designed and awkwardly placed controls, insufficient servicing capability, high cost, and lack of provision for adequate training of users. It is concluded that the present devices do not meet the needs of low-vision persons sufficiently, and that those manufacturers who solve these problems best will be the ones who survive.

302. MIMS, F.M. "Sensory aids for blind persons". In *The new outlook for the blind,* Vol. 67, No. 9, November 1973, pp. 407-414.

A number of travel aids, electronic reading machines and vision-substitution systems are described. The future prospects for sensory aids are discussed in the light of marketing problems, the interest (and lack of interest) of large companies in such research, and present levels of funding.

303. O'BRIEN, R. "The integrated resource room for visually impaired children". In *The new outlook for the blind,* Vol. 67, No. 8, October 1973, pp. 363-368.

A resource-room programme is discussed. The aim of the programme was to provide visually-impaired children, enrolled in regular classrooms, with individual instruction in the special skills they require. The special apparatus, low-vision aids and methods of instruction used are discussed. The selection of the school in which the programme was located, the selection of children for the programme and the use of staff are also discussed. The benefits of the programme for the children taking part are presented.

VIII. Publications of international organizations

A. PUBLICATIONS OF THE INTERNATIONAL LABOUR OFFICE (ILO)

304. *Automation in developing countries*. Geneva, ILO, 1972 (246 p.).

The volume brings together seven general analyses and six case studies which seek to examine the employment and output effects of changing technology, and the subsequent manpower and training requirements and implications.

305. *Education for development*. Report 3 of the Fifth ILO African Regional Conference, Abidjan. Geneva, ILO, 1977 (103 p.).

Discusses in detail the role of education in development, its relation to technological and economic programmes and the strategies which are being undertaken.

306. *Employment and training problems in new factories: a study on the recruitment and training of labour in newly established plants using advanced technology*. (CIRF Monograph No. 3.) Geneva, ILO, 1969 (153 p.).

Literature on the subject is reviewed and the statistical results of a sample survey which was conducted in seven European countries are presented and discussed. The major problems created by automation are not so severe in newer, and usually wealthier, firms but rather in smaller, neighbouring firms from which these new firms "poached" many of their employees. A further study of the secondary impact on other plants and in other industries is recommended as possibly useful for the final determination of the true effects of automation.

307. *Follow-up of the World Employment Conference: Basic Needs, Report VII*. Geneva, ILO, 65th Session, 1979 (145 p.).

A detailed report of the basic needs and employment needs in developing countries. Chapter 4 (devoted to employment problems and policies in *developed* countries) discusses in some detail the effect of technical changes (especially microprocessors) on employment and skills, together with the skill and retraining implications.

308. *Growth, structural change and manpower policy: the challenge of the 1980s*. Report I of the ILO Third European Regional Conference. Geneva, ILO, Oct. 1979 (139 p.).

This highly detailed report considers many economic, social and training requirements in relation to changing patterns of employment. Chapter 1 considers the role and prospects of growth; Chapter 2 analyses employment and unemployment in mixed economies and discusses means of reducing unemployment; Chapter 3 considers labour shortages; Chapter 4 discusses the need for readjustment and training; Chapter 5, the effect of the "new" technologies and Chapter 6 the influence of migrant labour.

309. *Guidelines for the development of employment and manpower information programmes in developing countries: a practical manual*. Geneva, ILO, 1979 (87 p.).

Provides a taxonomy and methodological approach to manpower planning (including training and retraining) in the face of changing employment conditions in LDCs.

310. *Human resources for industrial development*. (Studies and Reports, New series, No. 71.) Geneva, ILO, 1967 (276 p.).

The first part of this book discusses in particular problems connected with manpower in the developing countries.

In Section 2 (pp. 65-125) the authors condemn shortcomings in the vocational education system (quantity, quality of managers trained, unwarrantedly high teaching costs, lack of any true system). They propose a 3-pronged training strategy: phase 1 would identify qualifications requirements; phase 2 would lay down training goals; phase 3 would lay down broad teaching guidelines. The problem of programme-content and funding is also discussed.

A separate section is devoted to vocational training in small firms (pp. 157-187), where it is described as costly and often innappropriate.

311. *The Impact of multinational enterprises on employment and training*. Geneva, ILO, 1976 (33 p.).

Analysis of the impact of multinationals on employment in developed and developing countries.

The multinationals more or less directly improve technical training and educational standards in the host country by training their production personnel with the aid of a slightly different programme from the one used by local firms. Opportunities for local personnel to attain managerial positions depend on the "maturity" of the multinational, on the degree of standardization of the technology employed, and on obligations imposed by the host country.

312. G. KANAWATY (ed.). *Managing and developing new forms of work organisation*. (Management Development Series No. 16.) Geneva, ILO, 1980 (158 p.).

The text is divided into five parts. In part *one*, E. Thorsrud considers the changing role of worker and management. In part two, R. Lindholm and S. Flykt consider new concepts and thinking in the design of production systems. A. Malmburg in part *three* analyses the impact of job reform on accounting systems and part *four* N. De assesses the personnel implications and education factors. Finally, in part *five*, G. Kanawaty analyses the difficulty of introducing and developing new forms of work organisation.

313. *Labour and social implications of automation and other technological developments*. (ILO 57th session.) Geneva, ILO, 1972 (75 p.).

Automation and technological developments in general are not expected to bring about any significant change in the quantities of labour required, but they will affect the level and type of qualifications required. What modern technologies demand, far more than actual qualifications, is intellectual skills and flexibility, which go together under the name of "social skills".

The task of matching individual qualifications to the swift pace of change in techniques used is giving rise to a new conception of education which is already gaining a foothold in certain countries. "Knowledge is a perishable article" that needs regular renewal; the education system needs to be designed for periodic retraining, education shall become lifelong. At the same time, we need to discard the old barriers between technical and general education, between education and training. Lastly, education should seek to provide children with a solid background of basic knowledge coupled with greater ability to adapt to subsequent technological changes.

314. "Labour education: priority needs in the 80s", in *Labour education*, No. 42, 1980/1, pp. 6-14.

The paper is a summary of a paper prepared by J.R. Whitehouse, Chief, ILO Workers' Education Branch, for a seminar "The ILO in the 1980s" held at TGWU Centre, Eastbourne, U.K., 11-13 February 1980. The paper discusses future priority needs in relation to employment, unemployment and technical change and discusses (a) the subject-matter of workers' education, (b) problems of structure and (c) the financing of workers' education.

There is some discussion of workers' participation, the needs of women, rural workers and the young.

315. *Manpower forecasts in the iron and steel industry, and their impact on recruitment and vocational training of manpower in this industry.* (Report II of the Iron and Steel Committee, 9th Session.) Geneva, ILO, 1975 (70 p.).

This report is intended as a basis for discussion of the state of our knowledge of manpower forecasting, recruitment and training in the iron and steel industry. Chapter IV (pp. 46-63) discusses the training of workers necessitated by the introduction of new processes and ever more complex plant.

The training of production workers takes the form of on-the-job training supplemented by intensive theoretical instruction. For maintenance workers, training is both more specialized and more all-round (for adaptability), as required by modern preventive maintenance. The main task of steel industry training departments is to provide various forms of re-training and further training, to provide further training for good electricians and mechanics so as to turn them into electronics specialists and mechanical adjusters, both these being scarce. The training of foremen centres upon their technical skills and their flexibility.

Chapter IV also discusses programmed training, which is an interesting technique, and the training of older workers, who are regarded as just as capable of being trained as younger workers.

316. *Mechanization of the coal industry and its social consequences.* (Coal Industry Commission, 9th Session.) Geneva, ILO, 1970 (82 p.).

There is a trend in modern coalmines towards the modernization of extraction techniques by the introduction of new working methods and automation. There is reason to believe that developing countries are moving in the same direction.

Under these circumstances, the mining work force will increasingly be made up of specialists, especially in the supervisory grades. Demand for vocational training will rise at all levels of the hierarchy; miners will be expected to possess increasingly expert knowledge of the machinery used and to be able to maintain the machines themselves. Supervisory personnel will be expected to acquire new technical and managerial skills, engineers will have more extensive technical knowledge, while managers will be expected to keep abreast of the latest management methods.

317. *Multinational enterprises and social policy*. Geneva, ILO, 1974 (191 p.).

In the section on labour (pp. 27-68), this volume discusses the influence, which it regards as positive, of multinationals on vocational training in non-industrial countries. The multinationals provide vocational training for their personnel, in co-operation with the national educational system, and contribute to the raising of the general level of education. This training and recruitment policy raises certain problems for local firms; for example, it leads to what is considered as unfair competition in the labour market.

In addition, the multinationals provide further training for managerial executives from the host country.

318. *New forms of work organisation*. Geneva, ILO, 1979 (145 p.).

The text is a second volume in a range of studies concerned with changing working conditions based on the German Democratic Republic, India, Italy and the USSR. In several cases there are discussions of changing employment structure, training, educational needs, and job enrichment needs. A final chapter is devoted to economic costs and benefits of new forms of work organisation.

319. STOIKOV, V. *The economics of recurrent education and training*. Geneva, ILO, 1975 (115 p.).

The text analyses the value and costs of recurrent education programmes and also examines the barriers which restrain incentives to further education and training. General conclusions are reached both for developed and developing countries. Chapter 4 examines and discusses the depreciation of human skills in several contexts due to ongoing technological change.

320. *Vocational training and retraining of railwaymen*. (Inland Transport Committee, 10th Session.) Geneva, ILO, 1977 (47 p.).

The report analyses in fine detail the changing technological and systems structure of the rail system together with the impact on training needs and the development of training systems. Thus, Chapter 1, "Systems in Change", considers the rolling stock, technologies and changing administrative and management skills; Chapter 2, the impact on training needs for the unskilled, craftsmen, administrators and management; and Chapter 3, "Developing Training Systems", considers a wide range of training programmes.

321. *Working conditions and working environment in the petroleum industry, including off-shore activities*. Geneva, ILO (Petroleum Committee), Geneva, 1980 (116 p.).

The report discusses in detail the changing industrial and work styles together with the major occupational hazards in the industry, the effect of automation on skill requirements (pp. 69-73) and the ensuing training and job diversification needs.

322. *Young people and work*. Report II of the ILO Third European Regional Conference, Geneva, ILO, Oct. 1979 (66 p.).

"The report deals with the problems, needs and opportunities of young persons about to enter employment and of those who are gaining their first training and experience in employment. Emphasis is placed on the ways in which education, training, guidance and action relating to the working environment may assist them in taking (this) important step".

The text considers in Chapter 1: "Youth in Europe 1980-90; Chapter 2: Numbers and Activity Rates; Chapter 3: Job Prospects and Employment Opportunities (including changing structural pattern); Chapter 4: Schools and preparation for work; Chapter 5: Vocational Training in evolution and Chapter 6: co-ordinated policies for education and work.

B. PUBLICATIONS OF THE ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

323. *Alternation between work and education*. Paris, OECD (CERI), 1978 (97 p.).

This is a study undertaken by CERI to investigate the need, possibility and requirements of leaves of absence for educational programmes. The study suggests that the changing career patterns (in which technical change plays a part) point to a great need to institutionalise procedures for a wide range of recurrent educational practices.

324. CAIN, H.C. *Disadvantaged groups in the labour market and measures to assist them*. Paris, OECD, 1979 (68 p.).

The report considers the increasing pressure on various educationally, social and other disadvantaged groups in terms of employment shedding (or prospects arising from a range of changing economic, industrial and technical reasons) and considers the various educational, training and socio-economic policies which might be introduced or extended to assist these groups.

325. *Choice and adaptation of technology in developing countries*. (Development Centre Study Sessions.) Paris, OECD, 7-9 November 1972 (273 p.).

The multinational firms have made an important contribution to the developing countries by providing internal training courses for their employees, by supporting local foundations for education and scientific research, sometimes without any direct connection with the interests of the firm (p. 52).

326. CIBOIS, P., and MAKIEWICZ-LAGNEAU, J. *Students in short-cycle higher education (France, U.K. and Yugoslavia)*. Paris, OECD, 1976 (178 p.).

The report considers the institutional development "of post-secondary education of short duration with a strong vocational component, generally grouped under the 'non-university-sector' of higher education", which feed the requirements of middle-level manpower for industry and services. The report analyses the personal characteristics of the students in such institutions and the 'prestige' value of such institutions which may be critical in responding to ongoing changes in industrial and commercial demand.

327. *Conditions governing the success of technological innovation.* Paris, OECD, 1971 (197 p.).

The report looks for the sources of technological innovation in the OECD countries during the 1960s.

With their close links with industry, the universities are one of the factors underlying technological change; it is the demand for new technologies which tends to shape the production and structure of university knowledge (pp. 106-112). Furthermore (pp. 139-146), teaching is bound up with the scientific specialization of national technology, which itself depends upon the technological capabilities of the industrial firms and the nature of world markets, the latter factor being particularly unstable.

Lastly, the report emphasizes (pp. 149-152) the training of people to manage innovations emanating from the universities, which often stem from scientific research.

328. *Education and regional development - general report* (Volume 1). Paris, OECD, 1979 (91 p.).

This report summarises and provides a backcloth to a series of technical reports which consider the role of education policy in relation to regional development.

The various reports centre on three problems:

(I) The functions of education at regional level and in particular its relationship with employment and population migrations.
(II) Regional inequalities in education.
(III) The problem of planning and organisation raised by the regionalisation of education policies.

The technical reports by national authorities are published in Volume II of the report.

329. *Education and training for the metal worker of 1980.* Regional Trade Union Seminar, Paris, 8-11 October 1968: Final Report. Paris, OECD, 1968 (289 p.).

Considers what would be the tasks and the job profiles in the Metal Industry in 1980 particularly in two branches, machine tools and the automobile industry, as a result of the production processes and management methods which would be in use at that time. The vocational and general education needed by young people now entering school for them to meet the demands of these jobs and of society in 1980 are outlined. The state of vocational education and training in a number of countries is discussed. Reports prepared for the seminar by the rapporteurs and statements by employers' representatives are included.

330. *Education and working life in modern society*. Paris, OECD, 1975 (42 p.).

This is a report by the Secretary-General's Ad Hoc Group on the "Relations between Education and Employment", and considers in broad policy terms the "problem arising from the rapid expansion of education, changing employment and working conditions, and the role of the individual in contemporary advanced societies". The conclusions of the group include: a much greater need for the education and industrial/commercial sectors *together* to provide patterns for individual development, an increasing need to humanise work through technical change, an increasing emphasis on "recurrent education" and for more flexible interchange between education and work: in particular for young people in the formative stages of their working lives.

331. *Education in developing countries inside the OECD: trends and prospects*. Paris, OECD, 1974 (316 p.).

The development plans of the five countries concerned (Greece, Portugal, Spain, Turkey, Yugoslavia) stress the importance of education in economic development. The reforms envisaged cover the structure of the labour force, the distribution of qualifications among the population, the massive decline in farm labour, an expansion of employment in the non-farm sectors. Development may be achieved, provided human resources are better deployed, through the exapnsion of technical and informal education. Other objectives contained in these plans, on the other hand, such as the spread of national values, could act as an obstacle.

332. *Education policies and trends*. (A report by a group of experts). Paris, OECD, 1977 (44 p.).

The purpose of the report is "to identify and set out in a necessarily general (and in part normative) and long-term approach, the main trends and orientations of education policies in Member countries in the light of likely economic and social development prospects".

The trends in the relationship between education and employment point to the need for "increased opportunities for the development of skills and qualifications". The report argues that it is necessary to provide general qualifications which facilitate movement between occupations and that this can be done in part by "diversifying post-compulsory studies and offering opportunities for a broad-based occupational and technical training".

333. *Education policy and planning: goals for educational policy in Sweden*. Paris, OECD, 1980 (180 p.).

A report on compulsory schooling and higher education in Sweden prepared by the Ministry of Education and Cultural Affairs. The report considers the present structure of the education system in Sweden and also the future trends. Section 2 of the report briefly examines the relationship between education and employment, whilst section 4 considers a range of educational policy issues dependent upon changing conditions of work. In the concluding section the importance of contact with working life *outside* the formal school structure is emphasised.

334. *Entry of young people into working life* (General Report). Paris, OECD, 1977 (106 p.)

The report considers the problem facing young people in obtaining employment due to demographic, economic and industrial change factors; and the educational and special programmes which may be utilised to help the situation.

335. *Equal opportunities for women*. Paris, OECD, 1979 (219 p.).

This report considers the changing roles of women in the labour market and the relevance of education and training. Ongoing technological changes may affect women in particular. The difficulties facing women in attaining equal opportunity in education and training are considered.

336. *Future educational policies in the changing social and economic context*. Paris, OECD, 1979 (174 p.).

The report considers in part one the overall policy debate in relation to education and working life, whilst in part two there is an analysis of educational policy trends. The report lays much emphasis upon youth unemployment and changing skill requirements and the difficulties of the unskilled. It also considers the problem of "deskilling" which may be associated with ongoing technical change.

337. JENNESS, R.A. *Manpower and employment: problems and prospects*. Paris, OECD, 1978 (149 p.).

The study considers past manpower policies and employment trends and considers whether significant structural changes in employment have occurred in relation to industrial development. The future manpower supply and demand characteristics are then analysed.

The author also considers the difficulties which may be encountered in the next decade associated with "new labour force entrants (who) will have higher educational levels than those dictated by the labour market".

338. JEQUIER, N. *Appropriate technology directory*. Paris, OECD, 1979 (361 p.).

This is essentially a directory containing addresses and summaries of research programmes of numerous workers and institutions in nearly 100 countries who are concerned with the appropriate technology field. There are numerous references to educational aspects.

339. JEQUIER, N. (ed.). *Appropriate technology - problems and promises*. Paris, OECD, 1976 (344 p.).

As the title suggests the text reviews the entire area of appropriate technology in both its economic and social context. Several articles are concerned with educational aspects.

340. KOGAN, M. *Education policies in perspective: an appraisal*. Paris, OECD, 1979 (76 p.).

The document is essentially an analysis of the earlier review-programmes of the Education Committee of OECD which considers the national education policy of member countries. Whilst not specifically focusing on technical change the report is extremely valuable in providing a broad analysis of the changing role and perspective re-education policy vis-à-vis economic planning and in relation to employment: upon which changing policies geared to specific technical changes are highly dependent. There is extensive reference to differences in national patterns of vocational planning aspects, and how views have changed with time.

341. *The Management of Innovation in Education*. Report on a workshop held at St. John's College, Cambridge, 29 June - 5 July 1969. Paris, OECD, 1970 (67 p.).

This conference report on the administrative aspects and management of innovation in education covers educational planning and aspects of centralization and decentralization. It describes the setting-up of the project and its development. Also discussed are teacher training, financing, and technological change and innovation in practice.

342. *Migrations and transfers of technology.* (Case-studies: Algeria, Morocco, Tunisia and France). Paris, OECD, 1975 (183 p.).

Updated study on emigration to France from the Maghreb countries, with a discussion, in Chapter 4 (pp. 83-90), of the problem of the return of migrants to their country of origin; this aspect seems to affect the least skilled workers or workers whose skills are not needed in their country of origin. For reasons of upward social mobility, these people mainly seem to settle down in service sector jobs.

Practical solutions are put forward, such as getting migrants to form their own industrial firms, obliging host countries to provide their immigrant workers with a training suited to the needs of developing countries, and selective return of the best-qualified elements.

343. *Recurrent Education: trends and issues.* Paris, OECD (CERI), 1975 (58 p.).

Considers the increasing need for and importance of recurrent education in relation to a range of changing employment, work-style and social issues. The obsolescence of skills due to technical and industrial change is referred to with the implication that education for adaptability is an important criterion.

344. *Science and technology in the People's Republic of China.* Paris, OECD, 1977 (216 p.).

The report grew from a seminar held in 1976 under the auspices of the OECD Committee for Scientific and Technological Policy (CPST). Part I is concerned with Economic Development, Part II with Science and Science Policy and Part III with Manpower and Education. Other sections deal with "Technology and Economic Development" and also "The Ideological Context".

In Part III (Manpower and Education) education policies are dealt with "which have been chosen in order to attain scientific research and technological diffusion goals". Conclusions are drawn for manpower policy, educational methods and the issue of adapting education to societal need.

345. *Science, growth and society - a new perspective.* Paris, OECD, 1971 (163 p.).

Following disillusion with the sciences, as a result of the limited resources available for research and development, unemployment is beginning to make itself felt among scientists.

Further, as long as "social goals have yet to crystallize sufficiently" to result in definite technical programmes, it seems difficult to determine future demand for scientists and engineers in the OECD countries.

346. *The training of engineers: objectives and conception*. Paris, OECD, 1968 (326 p.).

Technical progress moves so swiftly that higher education often has difficulty adjusting to it. The scope of technical knowledge has expanded considerably. In addition, the engineer is no longer a Cartesian intellect concerned to apply the mathematical sciences to technical problems: now he is a practitioner concerned to solve concrete problems. His functions are no longer exclusively technical in nature; the human sciences are taking on growing importance in the management of the firm.

This study encompasses all these factors and proposes the creation of an advanced school of technology for industrial engineers in Seville. After reviewing the purpose and educational principles on which this school would be based, the report then goes on to propose programmes and the means and methods to implement them.

347. *Training policies for computer manpower and users*. (Informatics Studies No. 9.) Paris, OECD, 1975 (170 p.).

The report considers the training policy issues for computer manpower. Included in this report is the role of computer science in secondary education, the cost and technological requirements, training for management, recurrent and retraining issues and the impact on social structure.

C. PUBLICATIONS OF THE UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT (UNCTAD)

348. *International code of conduct for the transfer of technologies.* (Document TD/B/C6/AC1/2/Supp.1./Rev.1.) New York, UNCTAD, 1975 (pp. 38-39).

In Chapter VIII, paragraph D, the code denounces restrictions on employment and training of local personnel which compromise workable transfers of technology. Point 210 proposes the bases of a code on this specific point, in the form of more or less total prohibitions on the use of foreign personnel.

349. *Major problems arising out of the transfer of technologies to the developing countries* (doc. 10) - *Monograph on Spain* (doc. 17), *on Hungary* (doc. 18), *on Chile* (doc. 20), and *on Ethiopia* (doc. 22). (Document TD/B/AC.11/10 and TD/B/AC.11/17 to 21.) New York, UNCTAD, 1975.

Study of problems connected with technology transfers, with reference to the formation of the human capital needed to obtain a satisfactory match between research and the development of the country. The general study (doc. 10) also stresses the training of the personnel responsible for technology transfers.

350. *Reverse technology transfers: their dimensions, their economic consequences and their general political impact.* (Committee on technology transfers, Doc. TD/B/C.6/7.) Geneva, UNCTAD, 1975 (61 p. + appendixes).

This study begins with an examination of recent trends and the characteristics of exodus of skills (brain drain) between the developing countries and the three main industrial countries. The capital-value of this "reverse technology transfer" in fact turns out greater than the total public development aid supplied by the three developed countries. Immigration policies, moreover, tend to favour the highest occupational categories. The last chapter deals with possible measures to attenuate undesirable social consequences for the developing countries: charging an additional tax on the incomes of emigrant executives, mobilizing the tax revenues derived from immigrant executives in the host country for the benefit of the country of origin, etc.

351. *Technology transfers*. (3rd Session, Doc. TD/106.) Santiago, UNCTAD, 1972 (32 p. + appendixes).

Paragraphs 60-62 propose measures for the training of personnel specializing in technology transfers; organization at the inter-regional echelon, duration and type of training, funding.

D. PUBLICATIONS OF THE UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (UNESCO)

352. *African regional plan for the application of science and technology to development*. Conference of ministers of African Member States responsible for the application of science and technology to development (CASTAFRICA) Ref. 4. Dakar, Unesco, January 1974 (125 p.).

Chapter VIII contains a condemnation of the shortcomings of scientific and technical teaching in Africa. In primary and secondary schools, these are taught from a theoretical standpoint, with little regard to local conditions, and with inadequate financial resources. Vocational training turns out "workers and technicians that are unemployable on the spot". Higher education, which is patterned on that of the developed countries, is inappropriate to the country's needs too; the advanced technicians thus produced tend to take refuge in the university faculties, perpetuating in their turn a western-style pattern of education. This document puts forward goals and projects to improve the teaching of science and technology in Africa.

353. BAEZ, A.V. *Innovation in science education - worldwide*. Paris, Unesco Press, 1976 (249 p.).

Though this volume is more concerned with improvement of instructional techniques, part III (strategies for the future) is of relevance here. Similarly the annotated bibliography containing 101 references is very useful.

354. BEHRMAN, D. *Science and technology in development: a Unesco approach*. Paris, Unesco, 1979 (104 p.).

The booklet describes in popular terms Unesco's contributions to development through its programmes in science and technology, and includes a critical account of the failure of several programmes.

355. CARNOY, M. *Education and employment: a methodology for local policy research*. (Report Study No. S71, Division of Educ. Policy and Planning.) Paris, Unesco, 1979 (31 p.).

This is a "methodological" paper which concentrates on the role of education in meeting employment objectives in developing societies.

Firstly there is a review of basic research on education and employment; the second part is a review concerned with policy-oriented institutions and approaches are related to various methodological approaches and data-source basis. He then puts forward a research methodology which might be used in studying the relationship of education and employment. There is a discussion of the relevance or otherwise of "matching" of skill and training to employment needs.

356. *Combining education and work: experiences in Asia and Oceania.* Bangkok, Unesco Regional Office for Education in Asia and Oceania, 1978.

This is a series of booklets which emerge from the perceived problem "that the process of learning is separated from the context of action and work" and which therefore led to the "Interlinking of Education and Productive Work" theme. Each deals with a single country and examines in the context of that country a wide range of educational, technical and work issues. The countries covered are: Australia, Bangladesh, Socialist Republic of the Union of Burma, India, Malaysia, Nepal, New Zealand, Pakistan, Philippines, Singapore, Thailand, Socialist Republic of Viet Nam (in French), and the USSR.

357. *The Concept of functional literacy and its implementation.* (European round table on "Integrating literacy into economic development projects: the contribution of Italian firms".) Paris, Unesco, 1970 (26 p.).

Functional literacy is a response to the problem of underutilization of human potential.

Adapting to an industrial environment demands a profound change on the part of the individual, which is described in this brochure; one means to this change is functional literacy. While minor technological development in rural areas does not require additional knowledge, the introduction of sophisticated techniques and of modern management methods makes it necessary for peasants to acquire additional training.

358. *Curriculum design in engineering education.* (Progress report on the work of the Unesco International working group.) Paris, Unesco, 1976 (34 p.).

The report deals with the problem of modifying programmes with a view to improving co-operation between industry and education in the developing countries and to improving technology transfers.

359. DANCE, F.R. *Broadcast training techniques*. Paris, Unesco Press, 1976 (122 p.).

The text provides an overview and methodological appraisal of the use of broadcasting techniques for education and training. Extensive attention is given to the training process. Field work undertaken in Lagos and Kuala Lumpur is referred to.

360. *Educational reforms: experiences and prospects*. Paris, Unesco, 1979 (232 p.).

The text, comprising contributions by a group of senior officials involved in educational reform, considers a wide range of changing social, economic and technological issues which are pertinent to educational reform.

The text is divided into three parts; part one reviews experiences of educational reform in the 70s and prospects for the 80s; part two considers more specific aspects relating to educational reform, and part three comprises case studies. In this later section the study on the experience of educational reform in Sweden discusses certain manpower issues, whilst a chapter by A. Konan discusses educational reform and technological innovation: the Ivory Coast experience.

361. "Facts for filing: aspects of education in China". *Prospects*, Vol. V, No. 4, 1975 (pp. 512-536).

A series of 9 articles on education in China. Three articles deal with the assimilation of technology: HOUA, S., "Linking theory with practice" (pp. 519-520); HSUCH, F., "A factory run by a school in Peking (pp. 522-524); YI, T., "Agricultural schools in the countryside" (pp. 525-527). Theoretical training is closely interwoven with practical activities, and the education is designed to perfect the behaviour of pupils responsible for transmitting their technical knowledge to the rank and file.

362..*Final report of the Meeting of senior officials of the Ministries of Education of the 25 least developed countries*. (Conference of Ministers of Education of African Member States, Lagos, 27 Jan. - 4 Feb. 1976.) Paris, Unesco, 1976 (16 p.).

The report makes various suggestions concerning, in particular, major problems blocking educational renovation and development in the 25 countries, guidelines as to priority areas for international co-operation in education and possible ways to increase the amount and effectiveness of external assistance. The conclusions of the conference regarding three main areas: Education & fundamental choice, Education and work, and Education and culture, are given. One of the main aims of education should be to train skilled manpower at various levels and types necessary to improve the quality of life of the entire population. Education and training should be seen as an integral part of an overall national development process. Education for productive work is one of the most vital instruments for fighting poverty. Technical and vocational education is discussed. Increased mobility between education and work is recommended. Various factors which constrain the implementation of desired educational changes and reforms are also discussed.

363. *Functional literacy in Mali: education for development.* (Educational studies and documents No. 10.) Paris, Unesco, 1973 (70 p.).

Case study whose conclusions point to the beneficial influence of functional literacy on the popularization of technical themes and its links with the process of rural development.

364. *Impact of Science on Society.* Published quarterly by Unesco, Paris.

This journal, now reaching its 30th volume, contains many articles of relevance or general interest to the topic examined in this bibliography, and it is recommended that the reader scans several years in relation to his particular interests.
Volume 28 No. 2 April-June 1978 is devoted to Integrated Technological Transfer (I);
Volume 28 No. 4 Oct.-Dec. 1978 is devoted to Integrated Technological Transfer (II);
Volume 28 No. 3 July-Sept. 1978 is devoted to Computers and social options;
Volume 27 No. 4 Oct.-Dec. 1977 is devoted to "Engineering education today".
All these contain numberous articles of *general* pertinence to this bibliography.
Volumes which should also be consulted include:
Volume 29 No. 3 July-Sept. 1979 "Research and social goals"
Volume 30 No. 1 Jan.-Mar. 1980 "Women technicians in small countries"
Volume 30 No. 2 Apr.-June 1980 "Tomorrow's Homo faber: interaction between man and his tools".

365. *Industry and the training of engineers in Latin America (Formacion de ingenieros y la industria en America Latina).* (Latin American Seminar on co-operation between educational institutions and industria in the training of engineers, Cordoba, Argentina, 6-12 May, 1973. Montevideo, Unesco Field Science Office for Latin America, 1973 (254 p.).

The power to make policy in the different sectors of industry is an important goal of technological policy.

Autonomy in technological development involves the training of groups of technicians and scientists for industry and the universities, etc. This cannot be achieved in a short space of time where the country's technological level is too low. The goal of technological autonomy conditions the qualities expected of the education system, and in particular those of engineering science training institutions.

Part 1 of this study looks at industry's contribution to the training of engineers. Part 2 contains an inventory of the different contributions to the seminar.

366. *International social science journal*. Published quarterly by Unesco, Paris.

This journal is now in the 32nd volume. Whilst the majority of the articles are not so immediately relevant as those referred to under the *Impact of science on society* journal, it is recommended that the reader scans a range of years to note articles of general interest.

During 1979-80 the following articles are of relevance:
D.M. Guishiani - "Development problems, contemporary science and technology" (volume XXXII, No. 1, 1980, 151-158)
G.M. Dobrov - "Technology as a form of organisation" (volume XXXI, No. 4, 1979, 585-606)
S.E. Nilsen - "The use of computer technology in some developing countries" (volume XXXI, No. 3, 1979, 513-529).

367. KATSCH, G. *Technical co-operation among developing countries (TCDC): what does it mean for education towards a new international economic order?* (Report Study No. S58, Division of Education Policy and Planning.) Paris, Unesco, 1978 (34 p.).

This working document discusses the concept and validity of TCDC, and examines regional variations and the viability of the TCDC concept. In relation to this there is an analysis of the role which education has to play.

368. LADRIERE, J. *The challenge presented to cultures by science and technology*. Paris, Unesco, 1977 (165 p.).

Whilst not examining specific educational policies the text examines in great detail the problems confronting cultures in relationship to ongoing scientific and technological development, thereby providing a cultural backcloth against which educational issues may be more satisfactorily examined.

369. MORIO, S., and ZOETIZOUN, Y. *Two studies on unemployment among educated young people*. Paris, Unesco, 1980 (133 p.).

The text is split into two parts. Part I considers unemployment among educated young people in the *developed* market economy countries; and part II in the French-speaking *developing* countries. the role of technological change as a contributory factor and the policy dilemmas (including education policy) which ensue are discussed in detail.

The authors suggest that the present problem of unemployed youth is the result not of the education sector's failure to provide appropriate skills but of wider political, economic and industrial forces. Adjustment has therefore to be seen as a wider issue than mere educational reform.

370. MORSY, Z. (ed.). *Learning and working*. Paris, Unesco, 1979 (348 p.).

This text contains nearly twenty articles contributed by a range of senior educationalists, both academics and government officials, who discuss a wide range of education and work issues for both developed and developing countries. *Learning and working* is the first of a series of titles which will appear biennially and stem from *Prospects* Unesco's quarterly review of education.

371. *Moving towards change*. Paris, Unesco, 1976 (137 p.).

Unesco regards itself as directly concerned by the United Nations decision in May 1974 to call for the establishment of a new international economic order.

As a body concerned with problems of science and education, Unesco is especially interested in transfers of technology to the developing countries to create a fairer world society. The impact of this vision upon education becomes clear when Mr. M'bow, Director-General of Unesco, deals with the problems of the brain drain: "Are the discoverers of scientific knowledge - whether individuals or nations - entitled to appropriate that knowledge as their exclusive right? ... It is vital to have a world strategy for scientific research ..."; these quotations sum up

Unesco's basic thinking in this area.

In line with this same conception of the globalization of knowledge, the author spells out the efforts required of nations in the training of technicians. All too often educational systems are mere copies of those evolved by the industrial countries. Unesco has an important role to play in devising a process of change in the form of precise actions.

372. "New forms of co-operation in development research and training". *International social science review,* Vol. XXVII, No. 4, 1975 (pp. 846-852).

There are two antagonistic tendencies in research co-operation between industrial and developing countries: on the one hand there is the concern for independence shown by research institutes in the developing countries, while on the other there is a tendency to increased co-operation between the rich countries and those that are not.

To improve the integration of development research and training in the Third World, they must be redirected so as to make them better adapted to the needs of the Third World; the rich countries must be encouraged to shift their science policies towards the pursuit of research projects with immediate applications, towards research that will not have a paralysing effect on the developing countries; it is necessary to plan for increasing sources of aid to the developing countries and an extension of the fields of competence of researchers in the non-industrial countries; and co-operation must be established upon more selective, more efficient bases.

373. NOVOZHILOV, Y. *Transfer of science and technology and Unesco.* (International conference, "Transfer of Technology and Developing Countries", Belgrade, 9-11 September 1975.) Paris, Unesco, 1975 (10 p.).

A list of Unesco's actions to facilitate the transfer of technology, especially through university and post-university teaching.

374. *The propagation of new technologies in Africa.* Conference of ministers of African Member States responsible for the application of science and technology to development (CASTAFRICA) Ref. 3. Dakar, Unesco, January 1974 (28 p.).

Africa needs science and technology for its development, but it encounters numerous obstacles in its path, notably a shortage of skilled labour and technicians; consequently, imported techniques are ill-suited to local conditions and they fail to gain acceptance. The brain drain, which further exacerbates the lack of skills, could be slowed down by offering technicians attractive terms of employment. Proposals are made for future action to improve the match of vocational training to new technologies, and for the pooling of training resources.

375. SCHIEFELBEIN, E. *Education and employment in Latin America.* (Report Study No. S67, Division of Educ. Policy and Planning.) Paris, Unesco, 1979 (18 p.).

This study discusses the basic traits of the present employment situation in Latin America as well as historical trends. Included in this is a discussion of educational imbalances, technological change and labour mobility. A discussion of education policy against this background is then undertaken.

376. *Science and technology in the development of the Arab States - IV: Science and technology policy in the Arab states: present situation and outlook for the future.* (Science policy studies and documents No. 41.) Paris, Unesco, 1977 (pp. 27-35).

Summary of the Conference of Arab States' ministers responsible for the application of science and technology to development (CASTARAB). Paragraph 3, "Human resources for the application of science and technology to development", lists the salient points of discussions on improving secondary, university and post-graduate technical training, and the emigration of qualified Arab personnel.

377. *Scope and limitations of functional literacy: the Iranian experience.* (Educational studies and documents No. 9.) Paris, Unesco, 1973 (61 p.).

Chapter II discusses the social and economic situation in the three zones in which functional literacy programmes were implemented. The anticipated impact in the irrigated rural sector, in the modern industrial sector and in the handicrafts sector find their justification here: functional literacy must serve as a vehicle for the rapid integration of new technologies.

378. *Social sciences and humanities in engineering education.* Case studies and papers from the International Seminar on the Role of Social Sciences and Humanities in Engineering Education (Bucharest, September, 1972). Paris, The Unesco Press, 1974 (125 p.).

A general background paper and three case studies are presented which reflect a variety of points of view on the modernization and widening of engineering education. Further research and international co-operation is needed. This is considered essential for the adequate planning and modernization of the content of engineering education in response to the changing needs of society. Evidence is presented from Romania, the U.S.A., Japan and Chile. The conclusions and recommendations of the seminar are given and a summary of the conclusions and recommendations of the FEANI/Unesco seminar on Continuing Education of Engineers held in Helsinki in August 1972 are included in the appendixes.

379. *Studies in engineering education.* Paris, Unesco, 1974-77.

There are five volumes in this series:

1. *Standards for engineering qualification.* 1975, 106 p.
2. *Social sciences and humanities in engineering education.* 1974 124 p.
3. *The continuing education of engineers* (Proceedings of the FEANI Unesco Seminar, Helsinki, 1972), 1974, 191 p.
4. *Staff development for institutions educating and training engineers and technicians.* J.S. McNown, 1977, 127 p.
5. *The design of engineering curricula.* L.P. Grayson, 1977, 131 p.

All these provide a range of background material pertinent to technical change and engineering training; Volume 4 is a study dealing with the special problems of developing countries.

380. "Technology and general education". *Prospects,* Vol. IV, No. 1, 1974 (pp. 48-115).

A Unesco brief containing 8 articles around the idea of "opening up the school system to develop in the individual and society the capacity to absorb and produce technology":
The world fashioned by man (FOECKE, H.);
Technocracy and humanism (GEMINARD, L.);
The integral teaching of sciences in African primary schools (DYASI, H.);
Pre-vocational education in Sri Lanka (FERNANDO, T.);
Polytechnic education in the German Democratic Republic (NEUNOR, G.);
Reforming secondary education in Brazil (DUTRA DA FONCESA, G.);
The Open University (SPARKES, J.);
Problems and possible solutions (UNTERBRUNNER, H.).

381. TEDESCO, J.C. "Education and employment: the case of the industrial sector in Argentina". *Prospects,* Vol. IX, No. 1, 1979.

This case study is the final element of the "dossier" on "Education and development in Latin America" published in *Prospects,* Volume VIII, No. 3 and continued in No. 4 (1978). It considers the ongoing and changing role of education in relation to employment.

The author points to one of the dangers "of specific training to the hindrance of mobility and to an increased likelihood of unemployment due to technological obsolescence". A range of strategies for educational policy in relation to changing employment conditions are discussed briefly.

382. *Thinking ahead: Unesco and the challenges of today and tomorrow.* Paris, Unesco, 1977 (363 p.).

The text provides a general overview of what are considered to be dominant factors of world concern over the next few years and Unesco's current Medium-Term Plan for 1977-82. Section 4 is concerned with science and technology and Section 5 discusses a range of issues pertinent to technical change and education policy.

383. VON HAUMEDER, U. *Reflection on the future development of education: a selective and annotated bibliography.* (Report Study No. S70, Division of Educ. Policy and Planning.) Paris, Unesco, 1979 (74 p.).

Contains approximately 200 items relating to educational change, several of which are concerned with industry, training and technological issues.

E. PUBLICATIONS OF THE UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO)

384. *The development of technical study and design units in the developing countries*. Vienna, UNIDO, 1972 (74 p.).

The purpose of technical studies and design is to transform knowledge and ideas into material goods through the creation of a new product: the prototype.

The training of staff for technical study and design units begins with the selection of candidates on the basis of their creative aptitudes. Students should perfect their knowledge by working in firms or research centres, and should apply their knowledge and know-how by working on projects.

The training of staff for technical study and design units in the developing countries should be done by sending the ablest people on courses in the industrial countries. UNIDO experts are to provide assistance in setting up a teaching centre.

385. *Reports on the transfer of technical knowledge to developing countries through sub-contracting and licensing agreements*. Paris, UNIDO, November 1972.

An uneven collection of reports, some ideologically slanted. P. Racovic's report on an experiment in the Yugoslav car industry is outstanding; the experiment is described with precision where the training provided for employees is concerned.

F. PUBLICATIONS OF THE UNITED NATIONS ORGANIZATION (UNO)

386. *Declaration of the World Federation of Trade Unions on transnational corporations.* (United Nations Economic and Social Council, Document E/C.10/NGO/2.) New York, UNO, 2 March 1976.

The WFTU proposes the setting-up of an international body to control the activities of the transnational corporations. In addition, host countries are expected to devise a policy of "training for technical and scientific staff by establishing the infrastructure necessary for the training of these personnel categories, to be paid for out of taxation raised on foreign investment".

387. *Multinational companies and world development.* (United Nations Department of Economic and Social Affairs, Document ST/ECA/190.) New York, UNO, 1973 (195 p.).

Multinationals could make an important contribution to the training of local personnel. But the skills acquired are often of greater use to the firm than to national development (p. 56-58).

Addresses for additional information

Association for Science Education
College Lane
Hatfield
AL10 9AA

British Association for Commercial & Industrial Education (BACIE)
16 Park Crescent
London W1N 4AP
Tel: 01 636 5351 & 01 580 8131

British Institute of Management
Management House
Parker Street
London
WC2B 5PT

Council for Educational Technology for the U.K.
3 Devonshire Street
London W1N 2BA

Council of Science and Technology Institutes
47 Belgrave Square
London
SW1X 8QX
Tel: 01 235 6111

Department of Education and Science Library
Elizabeth House
York Road
London SE1

Department of Industry Library
1 Victoria Street
London
SW1 OET

Educational Foundation for Visual Aids
33 Queen Anne Street
London W1M 0AL

Institute of Physics
47 Belgrave Square
London
SW1X 8QX

The Institution of Chemical Engineers
15 Belgrave Square
London
SW1X 8PT

National Committee for Audio-Visual Aids in Education
33 Queen Anne Street
London
W1M 0AL

Schools Information Centre on the Chemical Industry
The Polytechnic of North London
Holloway Road
London
N7 8DB
Tel: 01 607 2789 *Contact:* Dr. Barbara Haines

School Technology Forum
National Centre for School Technology
Trent Polytechnic
Nottingham

Standing Conference on Schools Science and Technology
c/o The Institution of Mechanical Engineers
1 Birdcage Walk
London
SW1H 9JJ

Index of authors

Note: the references given in this index are to the annotation numbers, not to the pages on which they occur.

Abbott, W.L., 75
Addison, C.C., 150
Adiseshiah, M.S., 227
Agassi, J.B., 76
Ahmad, M., 228
American Foundation for the
  Blind, 295
Anderson, A., 77
Apter, M.J., 249, 250
Asarkov, J., 298
AUEW-TASS, 151
Australian Academy of Science, 39
Avakov, R., 1, 20, 21, 36, 53,
  203, 211, 221, 227, 231
Avscough, P.B., 251

Baez, A.V., 353
Barnett, C., 78
Barrett, G., 250
Barron, I., 40
Basil, D.C., 41
Becher, T., 42
Behrman, D., 354
Beishon, R.J., 79
Belbin, E., 80
Belbin, R.M., 80
Belitsky, A.H., 222
Bell, D., 204
Bell, M., 134
Bell, R.M., 152
Berg, I., 81
Bessant, J.R., 43, 205
Bhalla, A.S., 153
Blackaby, F., 206
Blair, L.M., 207
Blasch, B.B., 296
Blow, D., 252
Blum, A.A., 154
Boatwright, B., 137
Bobrov, L., 229
Bowne, J.R., 155
Bowers, R., 260, 299
Bowles, S., 208
Braverman, H., 82
British Association for the
  Advancement of Science, 156
Brown, J., 43
Burack, E.H., 83, 84
Burgraeue, P.R., 253
Business Education Council (U.K.),
  85

Cabinet Office, Advisory Council
  for Applied Research and
  Development (U.K.), 86, 157,
  158, 159
Cain, H.C., 324
Cain, J.T., 160
Campeau, P.L., 254
Canadian Association for Adult
  Education, 87
Cargill, B.F., 161
Carnoy, M., 44, 355
Carter, C., 2
Case, J.H., 244
Central Policy Review Staff
  (U.K.), 162
Cerych, L., 3
Cherns, A., 88
Chijioke, M.O., 230
Cibois, P., 326
Clark Trow, W., 255
Cole, S., 231
Collins, R., 89
Commission on Technology and the
  American Economy (USA), 256
Cook, C.W., 41
Cooke, R., 4

Coulson, E.H., 5
Council for Cultural Co-operation, 257
Council for Educational Technology (U.K.), 258
Crausas, R., 6
Critchlow, R.V., 163, 164
Crossman, E.R.F.W., 90
Crozier, D.J.S., 236
Curnow, R., 40

Dalton, G.W., 91
Dance, F.R., 359
Daniels, D.J., 7
Davidson, T., 296, 297
Davis, P., 298
Davis, T.C., 259
Degreene, K.B., 209
Delacourt-Smith, Lord, 92
Department of Industry (U.K.), 45
Department of Labour and National Service, Australia, 165
De Simone, 166
Dessay, J., 232
Dexter, C.R., 93
Dickson, E.M., 260, 299
Dickson, K., 43, 46, 205
Dieuzeide, H., 261
Dorozynski, A., 233
Douglas, S.D., 28
Dow, P.S., 244
Drucker, P.F., 210
Duffy, H., 167

Economist, The, 94
Edgley, R., 8
Educational Computing, 262
Educational Foundation for Visual Aids (U.K.), 278
Educational Foundation for Visual Aids in Education (U.K.), 278
Edwards, Sir S., 9
Eidell, T.L., 27
El Sammani, A.Y., 244
Emerson, G.S., 168
Encel, S., 211
European Communities, 95
European Industrial Relations Review, 96
European Trade Union Institute, 212

Fairbarn, A., 10
Famularo, J.J., 130
Fielden, J., 263
Finniston, M., 169
Fishwick, W., 170
Fomerand, J., 234
Forester, T., 47, 97
Fragnière, G., 213
Freeman, C., 48, 98, 99
Friedman, G.R., 301
Friedrichs, G., 100
Fulco, L.J., 171
Fyfe, J., 101

General Technology Systems (U.K.), 219
Gerber, W., 140
Goldish, L.H., 300
Gorman, L., 172
Graaff, J.H. van der, 234
Graden, F., 173
Griffin-Beale, C., 264
Gropper, G.L., 265
Guilbert, M., 102
Guillin, M., 266
Gulbenkian Foundation, 49

Hall, P., 267
Hallak, J., 235
Hammersley, P., 103
Hanson, J.W., 236
Harvard University Program on Technology and Society, 104
Haverland, E.M., 105
Hay, G., 11
Henderson, M., 174
Herman, A.S., 106
Hersleb, A., 77
Hewton, E., 290
Heywood, J., 50, 51
Hicks, B.L., 268
Hiestand, D.L., 175
Holding, D.H., 12
Hooper, R., 13, 269
Hubbard, G., 270
Huggett, C., 134, 195
Hunka, S., 268
Husén, T., 14
Husic, F., 116
Hutchins, R.M., 15
Hybels, J., 119

International Labour Office (ILO), 304, 305, 306, 307, 308, 309, 310, 311, 313, 314, 315, 316, 317, 318, 320, 321, 322

Irwin, P., 137
Ivey, L.T., 107

Jackman, M.E., 244
Jahoda, M., 52
Jenkins, C., 108
Jenness, R.A., 337
Jequier, N., 338, 339
Josefowicz, A., 244

Kamal Dow, J., 176
Kanawaty, G., 312
Kassalow, E.M., 109
Katritsky, A., 16
Katsch, G., 367
Kaufman, H.G., 178
Kennet, W., 214
King, K., 237
Kinunda, M.J., 244
Klein, J., 190
Kluchnikov, B.K., 53
Kogan, M., 42, 340
Komoski, P.K., 271
Konguetsof, L., 253
Korsakov, E., 110
Kotler, P., 272
Krishnamoorthy, C.S., 54
Kubota, G.H., 215

Ladrière, J., 368,
Lancaster, J.W., 111
Laner, S., 90
Large, P., 17
Laszlo, E., 18
Lauwerys, J.A., 19
Le Thanh, K., 20
Lecarme, O., 55
Lee, J.W., 111
Lefranc, R., 273
Leider, R.J., 112
Levinson, H.M., 179, 180
Lewis, P., 274
Lewis, R., 55
Licklider, J.C.R., 275
Linstone, H.A., 21
Lutz, B., 56

MacDonald, B., 276
Mack, D., 22
Maddock, I., 57
Maevskii, I., 238
Makiewicz-Lagneau, J., 326
Mallinson, P., 277
Mangum, G.L., 216
Manpower Service Commission (U.K.), 113
Mansfield, E., 116
Marcson, S., 74, 109
Marks, S., 283
Marlow, L.H., 23
Marsh, J., 43, 46
Marx, M.H., 300
Massarik, F., 127, 184
Mathews, D., 117
Maybury, R.H., 239
McCaffrey, G., 114
McKie, R., 115
McLean, J.M., 181
Melzer, A., 240
Mertens, D., 24
Meshel, Y., 58
Mesthene, E.G., 25, 217
Mims, F.M., 302
Mius d'Entremont, M., 253
Mondell Coger, R., 218
Morio, S., 369
Morsy, Z., 370
Mortimer, J.E., 118
Mueller, E., 119
Mullan, C., 172
Mundy, J.A., 59

National Academy of Engineering (USA), 60
National Committee for Audio-visual Aids in Education (U.K.), 278
National Council for Educational Technology (U.K.), 279
Needham, J., 280
New York State, Department of Labor, 120
Niblett, W.R., 26
Norman, C., 182
Norris, K., 290
Novozhilov, Y., 373

O'Brien, R., 303
O'Brien, T., 281
O'Carroll, F.T., 183
Odhiambo, T.R., 241
Oettinger, A.G., 282, 283
Organisation for Economic Co-operation and Development (OECD), 323, 325, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 341, 342, 343, 344, 345, 346, 347

Page, R., 68, 78
Parsons, S.A.J., 61
Pati, G.C., 83
Pavitt, K., 62
Pearson, A., 63
Pearson, P.K., 263
Peitchinis, S.G., 121
Pepino, L.F., 122
Perline, M.M., 123
Petch, S., 124
Peters, D., 277
Piele, P.K., 27
Porter, J., 125
Prasow, P., 126; 184
Psacharopoulos, G., 220
Pyle, L., 242
Pym, D., 12, 64, 79, 80, 128

Rahnema, M., 243
Rapoport, J., 116
Reisman, D., 28
Rezler, J., 129, 130
Roberto, D., 131
Roberts, I.F., 185
Robinson, E., 29
Robinson, L.A., 186
Romeo, A., 116
Rosemiller, B.E., 161
Rothwell, R., 187
Roy, G.K., 188
Rubin, M.L., 285
Rush, H.J., 181

Sadler, P., 30, 132, 189
Sanyal, B.C., 244
Savané, L., 245
Scanlon, E.G., 19
Schiefelbein, E., 375
Schlunder, E.V., 190
Schmidbauer, M., 284
Schmiedeskamp, J., 119
Schuller, T., 31
Sciberras, E., 65, 134, 195
Seear, Baroness, 133
Sefer, B., 221
Select Committee on Science and Technology (U.K.), 191, 192
Senker, P., 65, 66, 70, 134, 135, 136, 139, 193, 194, 195, 197
Shane, H.G., 32
Sherman, B., 108
Seidel, R.J., 285
Siegel, I.H., 222
Simmons, J., 223
Simpson, J.A., 33
Sleigh, J., 137
Smith, D., 196
Smith, R., 67
Smith, S.C., 27
Sonquist, J., 119
Sorensen, P.F., Jr., 84
Special Committee on Reorganisation and Development of Polytechnic Education in India, 246
Staelin, C., 119
Stanyon, R., 137
Stein, J.L., 138
Stoikov, V., 319
Stonier, T., 68
Suppes, P., 286
Swords, N., 69, 195
Swords-Isherwood, N., 65, 70, 139, 197

Tallman, C.B., 298
Taviss, I., 140, 154, 272, 286
Taylor, L.C., 287
Technology Policy Unit, University of Aston (U.K.), 141
Tedesco, J.C., 381
Thompson, P.H., 91
Times Educational Supplement, 142
Torda, T.P., 247
Tull, K.L., 123

Ullery, J.W., 288
United Nations Conference on Trade and Development (UNCTAD), 348, 349, 350, 351
United Nations Educational, Scientific and Cultural Organization (Unesco), 352, 356, 357, 358, 360, 361, 362, 363, 364, 365, 363, 371, 372, 374, 376, 377, 378, 379, 380, 382
United Nations Industrial Development Organization (UNIDO), 384, 385
United Nations Organization (UNO), 386, 387
U.S. Congress, House Committee on Education and Labour, Commission on Industrial Technology, 289
U.S. Department of Labor, Bureau of Labor Statistics, 143, 144, 145, 198, 199
University Grants Committee (U.K.), 146

Vaizey, J., 71, 290
Venning, M. 200
Venning, P., 72, 291
Versluis, J., 235
Viet, J., 292
Villani, E., 116
Von Haumeder, U., 383

Wagner, S., 116
Walker, R., 276
Wallace, W., 34
Wasser, H., 234
Weinberg, E., 147
Welch, F., 73
Welsh, R.L., 296
Whisler, T.L., 201
Whiston, T.G., 35, 36, 37, 148, 149, 224, 225
Williams, R.A., 185
Williams, S., 38
Willis, N., 293
Wirtz, W., 226
Wolfbein, S.L., 74

Zagefka, P., 203
Zegveld, W., 187
Zelikoff, S.B., 202
Ziel, H.R., 294
Zoetizoun, Y., 369
Zubkov, V.A., 248

IIEP publications and documents

More than 450 titles on all aspects of educational planning have been published by the International Institute for Educational Planning. A comprehensive catalogue, giving details of their availability, includes research reports, case studies, seminar documents, training materials, occasional papers and reference books in the following subject categories:

Economics of education, costs and financing

Manpower and employment

Demographic studies

The location of schools and sub-national planning

Administration and management

Curriculum development and evaluation

Educational technology

Primary, secondary and higher education

Vocational and technical education

Non-formal, out-of-school, adult and rural education

Copies of the catalogue may be obtained from the IIEP on request.

The International Institute for Educational Planning

The International Institute for Educational Planning (IIEP) is an international centre for advanced training and research in the field of educational planning. It was established by Unesco in 1963 and is financed by Unesco and by voluntary contributions from individual Member States.

The Institute's aim is to contribute to the development of education throughout the world by expanding both knowledge and the supply of competent professionals in the field of educational planning. In this endeavour the Institute co-operates with interested training and research organizations in Member States. The Governing Board of the IIEP, which approves the Institute's programme and budget, consists of eight elected members and four members designated by the United Nations Organization and certain of its specialized agencies and institutes.

Chairman	Torsten Husén (Sweden), Professor of Education and Director, Institute for the Study of International Problems in Education, University of Stockholm
Designated members	Samir Amin, Director, African Institute for Economic Development and Planning, Dakar P.N. Dhar, Assistant Secretary-General for Research and Analysis, United Nations T. Fülöp, Director, Division of Health Manpower Development, World Health Organization Aklilu Habte, Director, Education Department, International Bank for Reconstruction and Development
Elected members	Candido Mendes de Almeida (Brazil), Director, President of Foundation Sociedade Brasileira de Instruçao, Rio de Janeiro Jean-Claude Eicher (France), Director, Institute for Research in the Economics of Education, University of Dijon Mohy El Din Saber (Sudan), Director, Arab League Educational, Cultural and Scientific Organization (ALECSO) Michael Kinunda (Tanzania), Chief Administrative Officer, University of Dar-es-Salaam Waldo S. Perfecto (Philippines), Assemblyman, Republic of the Philippines; former Director, EDPITAF Jan Szczepanski (Poland), Vice-President, Polish Academy of Sciences Victor Urquidi (Mexico), Presidente, El Colegio de Mexico, Mexico

Inquiries about the Institute should be addressed to:
The Director, IIEP, 7-9, rue Eugène-Delacroix, 75016 Paris

This annotated bibliography is primarily concerned with the reciprocal relationships and interactions between those processes which are broadly termed 'technology' and 'education'. It is restricted to publications in English and primarily covers literature of the 1970s. Four aspects of the main theme have guided the choice of material to be included: first, the *implications* of technological change for educational policy; second, the *consequences* of educational policy upon technological changes; thirdly, the general *interaction* effect of both areas; and fourthly, the highly specific area of 'educational technology' - namely the specific application of various technological innovations within the education arena.

Issues of concern to both developed and developing countries are covered in this bibliography, and a section is devoted to the relevant publications of international organisations.

ISBN 92-803-1088-7